THE LIBRARY SMITHSONIAN INSTITUTION

SMITHSONIAN INSTITUTION THE LIBRARY

BULLETIN

OF THE

American Museum of Natural History.

Vol. XXX, 1911.

EDITOR, J. A. ALLEN.

NEW YORK:
Published by order of the Trustees.
1911.
FOR SALE AT THE MUSEUM.

American Museum of Natural History.

Seventy-Seventh Street and Central Park West, New York City.

BOARD OF TRUSTEES.

President.

HENRY FAIRFIELD OSBORN.

First Vice-President.

CLEVELAND H. DODGE.

Second Vice-President.

J. PIERPONT MORGAN, JR.

Treasurer.

CHARLES LANIER.

Secretary.

ARCHER M. HUNTINGTON.

EX-OFFICIO.

THE MAYOR OF THE CITY OF NEW YORK.
THE COMPTROLLER OF THE CITY OF NEW YORK.
THE PRESIDENT OF THE DEPARTMENT OF PARKS.

ELECTIVE.

ALBERT S. BICKMORE.
GEORGE S. BOWDOIN.
JOSEPH H. CHOATE.
THOMAS DEWITT CUYLER.
JAMES DOUGLAS.
MADISON GRANT.
ANSON W. HARD.
ADRIAN ISELIN, JR.
ARTHUR CURTISS JAMES.
WALTER B. JAMES.
A. D. JUILLIARD.
GUSTAV E. KISSEL*.
SETH LOW.
OGDEN MILLS.
J. PIERPONT MORGAN.
PERCY R. PYNE.
WILLIAM ROCKEFELLER.
JOHN B. TREVOR.
FELIX M. WARBURG.
GEORGE W. WICKERSHAM.

EXECUTIVE OFFICERS.

Director.

FREDERIC A. LUCAS.

Assistant-Secretary

GEORGE H. SHERWOOD.

Assistant-Treasurer.

THE UNITED STATES TRUST COMPANY OF NEW YORK.

* Deceased.

Scientific Staff.

DIRECTOR.

Frederic A. Lucas, Sc.D.

GEOLOGY AND INVERTEBRATE PALÆONTOLOGY.

Edmund Otis Hovey, A.B., Ph.D., Curator.
George Borup, A.B., Assistant Curator.

MINERALOGY.

L. P. Gratacap, Ph.B., A.B., A.M., Curator.
George F. Kunz, A.M., Ph.D., Honorary Curator of Gems.

INVERTEBRATE ZOÖLOGY.

Prof. Henry E. Crampton, A.B., Ph.D., Curator.
Roy W. Miner, A.B., Assistant Curator.
Frank E. Lutz, A.B., A.M., Ph.D., Assistant Curator.
L. P. Gratacap, Ph.B., A.B., A.M., Curator of Mollusca.
William Beutenmüller, Associate Curator of Lepidoptera.
John A. Grossbeck, Assistant.

Prof. William Morton Wheeler, Ph.D., Honorary Curator of Social Insects.
Alexander Petrunkevitch, Ph.D., Honorary Curator of Arachnida.
Prof. Aaron L. Treadwell, B.S., M.S., Ph.D., Honorary Curator of Annulata.
Charles W. Leng, B.S., Honorary Curator of Coleoptera.

ICHTHYOLOGY AND HERPETOLOGY.

Prof. Bashford Dean, A.B., A.M., Ph.D., Curator of Fishes and Reptiles.
Louis Hussakof, B.S., Ph.D., Associate Curator of Fishes.
John T. Nichols, A.B., Assistant Curator of Recent Fishes.
Mary Cynthia Dickerson, B.S., Assistant Curator of Herpetology.

MAMMALOGY AND ORNITHOLOGY.

Prof. J. A. Allen, Ph.D., Curator.
Frank M. Chapman, Curator of Ornithology.
Roy C. Andrews, A.B., Assistant Curator of Mammalogy.
W. DeW. Miller, Assistant Curator of Ornithology.

VERTEBRATE PALÆONTOLOGY.

Prof. Henry Fairfield Osborn, A.B., Sc.D., LL.D., D.Sc., Curator Emeritus.
W. D. Matthew, Ph.B., A.B., A.M., Ph.D., Curator.
Walter Granger, Associate Curator of Fossil Mammals.
Barnum Brown, A.B., Associate Curator of Fossil Reptiles.
William K. Gregory, A.B., A.M., Ph.D., Assistant Curator.

ANTHROPOLOGY.

Clark Wissler, Ph.D., Curator.
Pliny E. Goddard, A.B., A.M., Ph.D., Associate Curator.
Robert H. Lowie, A.B., Ph.D., Assistant Curator.
Herbert J. Spinden, A.B., A.M., Ph.D., Assistant Curator.
Charles W. Mead, Assistant.
Alanson Skinner, Assistant.

ANATOMY AND PHYSIOLOGY.

Prof. Ralph W. Tower, A.B., A.M., Ph.D., Curator.

PUBLIC HEALTH.

Prof. Charles-Edward Amory Winslow, M.S., Curator.
John Henry O'Neill, S.B., Assistant.

WOODS AND FORESTRY.

Mary Cynthia Dickerson, B.S., Curator.

BOOKS AND PUBLICATIONS.

Prof. Ralph W. Tower, A.B., A.M., Ph.D., Curator.
Ida Richardson Hood, A.B., Assistant Librarian.

PUBLIC EDUCATION.

Prof. Albert S. Bickmore, B.S., Ph.D., LL.D., Curator Emeritus.
George H. Sherwood, A.B., A.M., Curator.

CONTENTS OF VOLUME XXX.

	Page
Title-page	i
Officers and Trustees	iii
Scientific Staff	iv
Contents	vii
Dates of Publication of Author's Separates	viii
List of Illustrations	viii
List of New Names of Genera, Species and Subspecies	ix
Errata	xi
Art. I.— Polychætous Annelids from the Dry Tortugas, Florida. By Aaron L. Treadwell. (Twenty-nine text figures)	1
II.— Notes on Lantern Fishes from Southern Seas, collected by J. T. Nichols in 1906. By Charles H. Gilbert. (Two text figures.)	13
III.— Additions to the Ant-fauna of Jamaica. By William Morton Wheeler	21
IV.— A New Porpoise from Japan. By Roy C. Andrews. (Plates I and II and twenty-three text figures.)	31
V.— Fossil Coleoptera from Florissant, with Descriptions of several New Species. By H. F. Wickham	53
VI.— Fossil Insects from Florissant, Colorado. By T. D. A. Cockerell. (Plate III and three text figures.)	71
VII.— Eocene and Oligocene of the Wind River and Bighorn Basins. By W. J. Sinclair and Walter Granger. (Plates IV–IX and four text figures.)	83
VIII.— Revealing and Concealing Coloration in Birds and Mammals. By Theodore Roosevelt	119
IX.— Description of an apparently new Porpoise of the Genus *Tursiops*, with remarks upon a Skull of *Tursiops gillii* Dall. By Roy C. Andrews. (Plate X.)	233
X.— Mammals from Venezuela collected by Mr. M. A. Carriker, Jr., 1909–1911. By J. A. Allen	239
XI.— Notes on Teleostean Fishes from the Eastern United States. By John Treadwell Nichols. (Plate XI and one text figure.)	275
XII.— The species of *Brachyacantha* of North and South America. By Charles W. Leng. (Eighty-three text figures.)	279
XIII.— Mammals collected in the Dutch East Indies by Mr. Roy C. Andrews on the cruise of the 'Albatross' in 1909. By J. A. Allen	335
XIV.— The Generic name *Cercopithecus*. By D. G. Elliot, D. Sc., F. R. S. E., etc.	341
XV.— The North American species of *Dryophanta* and their Galls. By William Beutenmüller. (Plates XII–XVII.)	343

DATES OF PUBLICATION OF AUTHOR'S SEPARATES.

The edition of Author's Separates is 300 copies, of which about 100 are mailed on the dates of issue, and the others placed on sale in the Library.

Art. I,	March 10, 1911.	Art. IX,	Aug. 26, 1911.
" II,	" 10, 1911.	" X,	Dec. 2, 1911.
" III,	May 26, 1911.	" XI,	" 2, 1911.
" IV,	" 16, 1911.	" XII,	" 21, 1911.
" V,	" 26, 1911.	" XIII,	" 21, 1911.
" VI,	" 26, 1911.	" XIV,	" 21, 1911.
" VII,	July 11, 1911.	" XV,	" 30, 1911.
" VIII,	Aug. 23, 1911.		

LIST OF ILLUSTRATIONS.

Plates.

I.— *Phocœnoides truei*, external views.
II.— " " lateral and ventral views of peduncle.
III.— Fossil Insects from Florissant, Colorado.
IV.— Beaver Divide, Wyoming, two views.
V.— (1) Wasatch clays, near Otto, Bighorn Co., Wyom.; (2) Lone Butte, Beaver Divide.
VI.— Eocene-Oligocene section near Hailey, Wyom.
VII.— Lambdotherium zone, Wind River badlands.
VIII.— Beaver Divide, geologic views.
IX.— Badlands, Bighorn Co., Wyom.
X.— Skull of *Tursiops nuuanu*, three views.
XI.— *Moxostoma alleghaniensis* and *Stathmonotus teckla*.
XII–XVII.— Galls of the North American species of *Dryophanta*.

Text Figures.

	Page
Marphysa fragilis, head	2
" " parapodium	3
" " dorsal and ventral seta	3
" " 33d parapodium	4
" " mandible	4
Aracoda attenuata, jaw apparatus	5
" " dorsal view and maxillæ	6
Aracoda spatula, head, maxillæ, and posterior parapodium	7
Necidion kinbergii, head and anterior parapodium	7
" " posterior parapodium, and simple, comb-shaped, and compound setæ	8
" " mandible and maxillæ	9
Hermenia verruculosa, anterior dorsal view	10
" " parapodium	10
" " small elytron	11

PAGE

Streblosoma verrilli, head, somite 1, etc. 12
Lampanyctus nicholsi, lateral and ventral views 18
Phocænoides truei, pectoral and dorsal fins 32
" " head and anterior part of body 33
" " dorsal view of skull 37
" " ventral " " " 38
" " lateral " " " 39
" " lateral view of mandible 40
" " basihyal and thryohyals 41
" " atlas and cervical vertebræ 42
" " first dorsal vertebræ 43
" " first lumbar vertebra, lateral view 44
" " " " " dorsal " 45
" " " " " " " 46
" " first caudal vertebræ, lateral view 46
Phocæna phocæna, " " " " " 46
" " " " " dorsal view 47
Phocænoides truei, " " " " " 47
" " sturnum 48
" " right scapula 49
" " pectoral fin 51
Paussopsis nearctica 71
Chrysobothris gahani 72
Necropsylla rigidula 73
Sketch map of Wind River Basin 84
Diagrammatic sections across the Wind River and the Big Horn basins 88
Sections of Tertiary deposits, Beaver divide 89
Sketch map of a portion of the Bighorn basin 106
Synotus fœtidus 278
Brachyacantha bistripustulata, head and thorax 282
" *dentipes*, front leg 282
" *decora*, *dentipes*, and *arizonica*, front tibia 282
" *dentipes*, claws 283
" *4-punctata*, genitalia 284
" *bistripustulata*, abdomen 286
" *ursina*, *albifrons*, and *dentipes*, abdomen 287
" *pygidialis* and *lepida*, abdomen 288
" elytra of various species and varieties 330, 332

LIST OF GENERA, SPECIES, SUBSPECIES, AND VARIETIES FIRST DESCRIBED OR RENAMED IN THIS VOLUME.

GENERA.

PAGE

Phocænoides Andrews 31
Myiodysticus Wickham 54
Paussopsis Cockerell 71
Eucallimyia Cockerell 82

New Species, Subspecies, and Varieties.

	Page
Marphysa fragilis Treadwell	2
Aracoda attenuata Treadwell	5
" *spatula* Treadwell	6
Streblosoma verrilli Treadwell	11
Lampanyctus nicholsi Gilbert	17
Anochetus mayri læviusculus Wheeler	22
Pheidole caribbæa Wheeler	23
" (*Ceratopheidole*) *hecate* Wheeler	26
" " " *malevola* Wheeler	27
Strumigenys alberti var. *nigrescens* Wheeler	28
Phocænoides truei Andrews	32
Harpalus maceratus Wickham	54
Myiodysticus hirtipes Wickham	54
Hydrobius prisconatator Wickham	55
Dryops eruptus Wickham	56
Dascyllus lithographus Wickham	57
Lymexylon lacustrinum Wickham	57
Ceruchus fuchsii Wickham	58
Aphodius florissantensis Wickham	59
Lygyrus compositus Wickham	59
Elaphidion fracticorne Wickham	60
Callimoxys primordialis Wickham	61
Colaspis ætatis Wickham	61
Diabrotica exesa Wickham	62
Synchroa quiescens Wickham	62
Toxorhynchus grandis Wickham	63
Otiorhynchites florissantensis Wickham	64
Cyphus subterraneus Wickham	64
Geralophus scudderi Wickham	65
Apion cockerelli Wickham	65
Cleonus rowheri Wickham	66
Magdalis striaticeps Wickham	66
Balaninus minusculoides Wickham	67
Scyphophorus tertiarius Wickham	68
Cratoparis adumbratus Wickham	69
Paussopsis nearctica Cockerell	71
Chrysobothris gahani Cockerell	72
Andrena grandipes Cockerell	73
Eriocampa synthetica Cockerell	74
Necropsylla rigidula Cockerell	75
Leia miocenica Cockerell	76
Plecia melanderi Cockerell	77
Symphoromyia subtrita Cockerell	78
Asilus amelanchieris Cockerell	79
Teracticus renovatus Cockerell	80
Megacosmus secundus Cockerell	80
Eucallimyia fortis Cockerell	82

PAGE
Tursiops nuuanu Andrews 233
Cavia porcellus venezuelæ Allen 250
Loncheres carrikeri Allen 251
Urocyon cinereoargentea venezuelæ Allen 259
Chilonycteris rubiginosa fusca Allen 262
Moxostoma alleghaniensis Nichols 275
Brachyacantha 12-guttata Leng 294
" *trimaculata* Leng 295
" *sicardi* Leng 295
" *bistripustulata quichiana* Leng 298
" " *minor* Leng 298
" " *obscura* Leng 298
" *dentipes separata* Leng 301
" " *americana* Leng 302
" *australe* Leng 313
" *fenyesi* Leng 316
" *mexicana* Leng 316
" *lepida reducta* Leng 325
Mus andrewsi Allen 336
Mus buruensis Allen 336
Sciurus beebei Allen 338
Tamiops sauteri Allen 339

ERRATA.

Page 43, footnote, for *P. truei* read *P. dalli*.
" 49, line 7, for more read less.
" 89, at bottom, insert Feet over column of figures.
" 90, at top, insert Feet over column of figures.
" 98, lines 10 and 11, for Plate VI read Plate IV.
" 98, line 12, for Plate IV, Fig. 2, read Plate VIII, Fig. 1.
" 98, footnote, read Granger, *loc. cit.*, etc.
" 110, at bottom, omit last sentence.
" 116, line 10, for have been from read have been derived from.
Plate VII, in the legends, for Big Land Draw read Big Sand Draw.

12

BULLETIN

OF THE

American Museum of Natural History.

Vol. XXX, 1911.

EDITOR, J. A. ALLEN.

FEB 21 1912
220508
National Museum

NEW YORK:
Published by order of the Trustees.
1911.
FOR SALE AT THE MUSEUM.

Continued from 3rd page of cover.)

PART II.— The Chuckchee: Religion. By W. Bogoras. Pp. 277–536, pll. xxxii–xxxiv, and 101 text figures. 1907. Price, $4.00.

PART III.— The Chuckchee: Social Organization. By W. Bogoras. Pp. 537–733, pl. xxxv, and 1 text figure. 1909. Price, $3.00.

Vol. XII. Anthropology (not yet completed).

**Jesup North Pacific Expedition, Vol. VIII.*

PART I.— Chuckchee Mythology. By Waldemar Bogoras. Pp. 1–197, 1910. Price, $1.25.

Vol. XIII. Anthropology (not yet completed).

**Jesup North Pacific Expedition, Vol. IX.*

PART I.— The Yukaghir and the Yukaghirized Tungus. By Waldemar Jochelson. Pp. 1–133, pll. i–vii, 1 map. Price, $3.40.

Vol. XIV. Anthropology.

**Jesup North Pacific Expedition, Vol. X.*

PART I.— Kwakiutl Texts. Second Series. By Franz Boas and George Hunt. Pp. 1–269. 1906. Price, $2.80.

PART II.— Haida Texts. By John R. Swanton. Pp. 271–802. 1908. Price, $5.40.

ETHNOGRAPHICAL ALBUM.

Jesup North Pacific Expedition.

Ethnographical Album of the North Pacific Coasts of America and Asia. Part 1, pp. 1–5, pll. 1–28. August, 1900. Sold by subscription, price, $6.00.

BULLETIN.

The matter in the 'Bulletin' consists of about 24 to 36 articles per volume, which relate about equally to Geology, Palæontology, Mammalogy, Ornithology, Entomology, and (in former volumes) Anthropology, except Vol. XI, which is restricted to a 'Catalogue of the Types and Figured Specimens in the Palæontological Collection of the Geological Department,' and Vols. XV, XVII, and XVIII, which relate wholly to Anthropology. Volume XXIII and the later volumes contain no anthropological matter, which is now issued separately as 'Anthropological Papers.'

Volume	I, 1881–86	Out of print	Volume XVII, Part	IV, 1905	Price, $ .75
"	II, 1887–90	Price, $4.75	" "	V, 1907	" 1.25
"	III, 1890–91	" $4.00	" XVIII, "	I, 1902	" 2.00
"	IV, 1892	" 4.00	" "	II, 1904	" 1.50
"	V, 1893	" 4.00	" "	III, 1905	" .50
"	VI, 1894	" 4.00	" "	IV, 1907	" 2.00
"	VII, 1895	" 4.00	" XIX, 1903		" 6.00
"	VIII, 1896	" 4.00	" XX, 1904		" 5.00
"	IX, 1897	" 4.75	" XXI, 1905		" 5.00
"	X, 1898	" 4.75	" XXII, 1906		" 6.00
"	XI, 1898–1901	" 5.00	" XXIII, 1907		" 9.00
"	XII, 1899	" 4.00	" XXIV, 1908		" 6.00
"	XIII, 1900	" 4.00	" XXV, Part I, 1908		" 1.50
"	XIV, 1901	" 4.00	" XXVI, 1909		" 6.00
"	XV, 1901–1907	" 5.00	" XXVII, 1910		" 5.00
"	XVI, 1902	" 5.00	" XXVIII, 1910		" 4.00
"	XVII, Part I, 1902	" 1.50	" XXIX, 1911		" 4.50
"	" " II, "	" .75	" XXX, 1911		" 4.00
"	" " III, 1905	Out of print			

ANTHROPOLOGICAL PAPERS.

Volume	I, 1908	Price, $3.50	Volume IV, 1910		Price, $3.50
"	II, 1909	" 3.50	" V, 1911		" 3.50
"	III, 1909	" 3.50	" VI, 1911		" 3.50

AMERICAN MUSEUM JOURNAL.

The 'Journal' is a popular record of the progress of the American Museum of Natural History, issued monthly, from October to May inclusive. Price, $1.00 a year. Volumes I–XI, 1900–1911.

*The Anatomy of the Common Squid. By Leonard Worcester Williams. Pp. 1–87, pll. i–iii, and 16 text figures. 1909.

*Chinese Pottery of the Han Dynasty. By Berthold Laufer. Pp. 1–339, pl. i–lxxv, and 55 text figures. 1909.

For sale at the Museum.

*Published by E. J. Brill, Leiden, Holland. Not on sale at the Museum. American Agent, G. E. Stechert, 129 West 20th Street, New York City.

BULLETIN

OF THE

AMERICAN MUSEUM OF NATURAL HISTORY.

VOLUME XXX, 1911.

59.51,7(75.9)

Article I.—POLYCHÆTOUS ANNELIDS FROM THE DRY TORTUGAS, FLORIDA.

BY AARON L. TREADWELL.

The following is the first of a proposed series of systematic papers on the polychætous annelids of the southeastern United States and West Indian regions. I have collections made by the American Museum expedition in the Bahamas in 1908, in Bermuda by Professor Verrill, to whose generosity I am indebted for an opportunity of studying them, and by myself while at the Laboratory of the Carnegie Institution at the Dry Tortugas. To the Director of this laboratory, Dr. Alfred Goldsborough Mayer, I am under the greatest of obligations for many courtesies, and for the facilities of the laboratory which he put at my disposal.

The majority of the annelids at the Tortugas live in the crevices of the dead coral rock, or in some cases in canals penetrating the solid part of this rock, these canals sometimes fitting the bodies of the animals so closely that they seem to have been excavated by the animals. Tube dwelling forms, as Sabellids and Serpulids, live in or among the heads of the living coral, and in the mud in the moat at Fort Jefferson. There are no mud flats in this region, the annelids usually found in such places living in the dead coral.

To secure satisfactory results in Annelid collecting, preliminary narcotization is essential, and for this purpose I have found a solution of $MgSO4$, at a strength of 153.74 grams to the litre, gives the best results. This was devised by Dr. Mayer, and used by him for a variety of other animals. When completely narcotized, they are transferred to 5 % formalin until dead, and are then fixed in 90 % alcohol. It is usually desirable in order

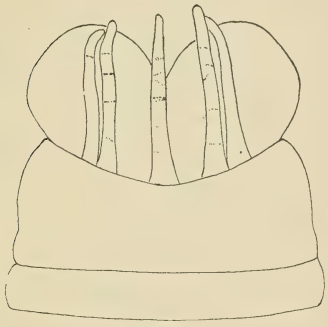
to avoid shrinking to run them down to 50 % alcohol, returning to 80 % for final preservation. This method preserves both form and color very well. Final preservation in formalin is to be avoided, as specimens in it have a tendency to macerate.

Marphysa fragilis n. sp.

A number of specimens found July 2, 1910, in the crevices of soft coquina rock left bare by the tide at Loggerhead Key just south of the laboratory landing. The animals were very fragile, and it was difficult to remove them from the rock without breaking. Some were apparently broken when found and later examination showed in these various stages of regeneration of the posterior ends.

Only one specimen, and that a small one, was removed entire. This had a width of 7 mm. and a total length of 50 mm., with about 160 somites.

Head (Fig. 1) bilobed, each lobe with rounded anterior margin, and slight lateral protrusion. Peristomium about four times broader than long, length in mid line about one third less than at lateral margin. Anterior margin slightly prolonged to cover the bases of the tentacles. Tentacles five, of nearly equal length, the outer pair a trifle longer than the inner. Each tapers gradually from the base to a bluntly rounded apex. Transverse bands of brown pigment, in some cases not complete, cross the tentacles in various places and give a certain resemblance to articulations. Eyes one pair, obscure, between bases of paired tentacles, completely covered by anterior margin of peristomium.



1

Fig. 1. Head of *Marphysa fragilis.* × 7.5.

Somite 2 about one third as long as peristomium, its width equal to about ten times its length. Somites 4 to 9 show a gradual increase in length, the width of somite 9 being about equal to 7 times its length. Behind this, the somites gradually decrease in length, width of somites in the gill bearing region being at least 14 times their length. This is, however, variable, depending on the amount of contraction. For the greater part of the posterior half of the body, the intersegmental constrictions are especially prominent, so that the somites seem to be relatively narrow, colorless rings, separated by broad and deep dark colored furrows. Ventral surface rather less rounded than dorsal and intersegmental grooves less pronounced. Anterior somites decidedly rounded dorsally with parapodia situated ventro-laterally. Those of somites 3 to 10 show a gradually more elevated position, the 10th being on the lateral margin. Succeeding somites resemble this in the position of the parapodia. Toward the posterior end the dorsal surface again shows a tendency to round and the parapodia are again nearer the ventral than

dorsal surface. Pygidium of entire specimen showed no trace of anal cirri. A regenerating one had two ventrally placed stout cirri.

First parapodium (Fig. 2) with blunt ended basal portion. Dorsal cirrus constricted at base, terminal portion lanceolate, extending to three times length of basal portion. Ventral cirrus broader than dorsal, in form of a truncated cone. Large conical posterior lobe resembling ventral cirrus in outline, but more slender. Dorsal cirri of next three or four appendages much like those of first, but gradually decrease in length, finally being barely as long as the basal portion of the appendage. Ventral cirrus on third somite begins to show a differentiation into a small rounded terminal portion and a thick ventral pad which is prominent up to about somite 25. Behind this region it becomes relatively inconspicuous, but the two parts of the cirrus may be distinguished throughout the body. Posterior parapodial lobe prominent anteriorly, but disappears behind the region of the 30th appendage.

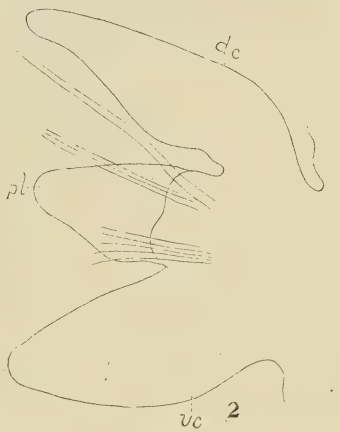


Fig. 2. Parapodium of *Marphysa fragilis.* × 25. *d. c.*, dorsal cirrus; *v. c.*, ventral cirrus; *pl*, posterior lobe.

Setæ of all somites in a dorsal and a ventral bundle. Anteriorly in dorsal bundle are three kinds. 1. Long, slender, slightly curved, with feebly toothed narrow marginal expansion. 2. Setæ somewhat like 1, but shorter, and more curved (Fig. 3) and marginal expansion with fine denticulations. 3. A few very delicate comb-shaped setæ, situated dorsal to the base of 1, with elongated lateral teeth, and 12 to 15 intermediate ones. These latter are very delicate, and difficult to see. Ventral setæ in a dense bundle, all compound. Basal joint long, its distal expansion pointed and covered with minute spines (Fig. 4). Terminal joint relatively short, with two stout hooks at end, covered with a hood. Edge of hood with minute denticulations throughout its whole extent. Five or six very stout blunt-pointed aciculæ in middle of parapodium. Behind the fourth somite these are replaced by two black aciculæ, which project from the end of the parapodium, and can be seen with a hand lens. Throughout posterior region of body the same sorts of setæ appear as on the anterior somites, but are all somewhat modified. The comb-shaped setæ here form a dense tuft at the dorsal side of the base of the long setæ, while the shorter of the two forms of long ones have more prominent lateral teeth than they do anteriorly. Compound setæ are similar to anterior ones, but with much longer basal joints.

Fig. 3. Dorsal seta of *Marphysa fragilis.* × 185.

Fig. 4. Compound ventral seta of *Marphysa fragilis.* × 280.

Gills begin on somites 16 to 19. The first with one or two branches, which

increase in number and size on later somites, five being the greatest number of branches seen on any one gill. They are prominent and are long enough to cover the back, though at least in preserved material, are bent posteriorly so that the middle

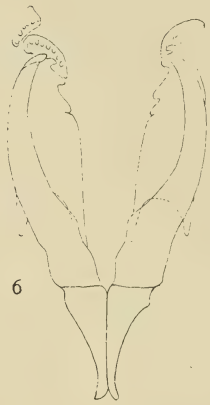


Fig. 5. 33rd parapodium of *Marphysa fragilis.* × 14.
Fig. 6. Maxillæ of *Marphysa fragilis.* × 10. The tip of the right forcep had been broken.

of the back is not covered. They are most prominent on somites 20 to 50, behind this point diminishing both in size, and in number of branches. On one entire specimen having a total length of 50 mm. with about 160 somites, gills began on somite 20 and ended on 100. Fig. 5 is of a posterior view of the 33rd parapodium.

Fig. 7. Mandible of *Marphysa fragilis.* × 10.

Maxillæ (Fig. 6) with slender dark colored base, terminal portion gently curved, proximal part lighter colored than distal. Left paired plate with 3 strong teeth, right with 3 large and 1 small tooth. Second paired plates with 7 small teeth each. Left unpaired with 2 stout, and 4 smaller teeth. All teeth very dark colored, general surface of plate much lighter. Mandibles (Fig. 7) long, slender, light brown with darker edges. Terminal plates pearly white.

Living specimens showed the anterior and ventral surfaces of the prostomium white, dorsal surface as far as bases of antennæ brown, portions between bases of antennæ white, with brown arch around bases of unpaired and inner paired antennæ. Brown patch on head continued in a patch on top of each palp. A number of brown rings around the antennæ, varying in number on different antennæ and different animals, but usually 3 or 4. Prostomium brown, densely covered with pearly white spots, next 3 somites with lateral areas like head, but with prominent pearly white patch in mid-dorsal line, also with fewer white spots on lateral area than in head. These dorsal patches

become less prominent on somites 3 and 4 and disappear entirely on 5, to reappear on 7. They are less prominent on 8 and 9, while 10 is entirely white. Later somites show a median white patch on dorsal surface, which as far as at about somite 25 is continuous with a transverse band across the anterior face of the somite. Behind this region, entire surface of animal pearly white. Ventral surface throughout similar in color to posterior dorsal region. The whole surface of the animal is highly iridescent. Gills bright red. Alcoholic specimens show practically the same coloration as living material, though the gill coloration, being due to contained blood, is entirely lost.

This is apparently closely related to *Leodice* (*Marphysa*) *hamata* of Schmarda from Jamaica, though according to Schmarda's description that has bidentate aciculæ, and the gills begin near the middle of the body, and have only two branches.

Type in American Museum of Natural History.

Aracoda attenuata n. sp.

An extremely attenuated animal, fairly abundant in the coral rocks. They occupy small tubes in the rocks, just large enough to accommodate the body, and usually are first seen when, the rock having been split open, the delicate body, usually narrowed to the diameter of a fine thread, is found stretching across from one piece to the other. It is practically impossible to remove the animal from the burrow without breaking. One incomplete specimen of average size had (in alcohol) a diameter of barely 1 mm., with a length of 120 mm., over 200 somites being present. The body is noticeably narrower for the anterior 100 somites than it is farther back.

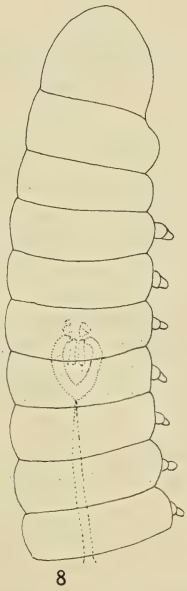


Fig. 8. Anterior end of *Aracoda attenuata.* × 45. The jaw apparatus showing through the body wall.

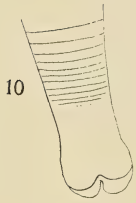
Fig. 9. Seta of *Aracoda attenuata.* × 500.

Head (Fig. 8) broadly rounded, length about equal to breadth. (The figure was drawn from an animal partly rolled on its left side.) First two somites about as wide as head. Appendages begin on somite 4. Each with a bluntly ending basal portion, carrying setæ, and a prominent conical ventral lobe extending beyond the basal portion to a distance rather less than height of latter.

Setæ (Fig. 9) of only one kind, with long, rather stout base, terminal portion bent and prolonged into an acute tip, and with a sharply toothed expansion along convex edge. On some appendages were short very delicate setæ just protruding from the end. These seemed to me to be merely the ends of developing setæ of above type.

Toward posterior end the parapodia disappear and somite boundaries are hard to distinguish. Pygidium with dorsal and ventral paired lobes, but no cirri. This may possibly have been a regenerating individual (Fig. 10).

Jaw apparatus jet black. Maxillæ rather stout, tapering to a blunt point. 1st pair of toothed plates between maxillæ, each with 6 large and a small 7th tooth. Terminal paired plates with one long and one short tooth. Middle plates with one long and 4 much shorter teeth (Fig. 11).



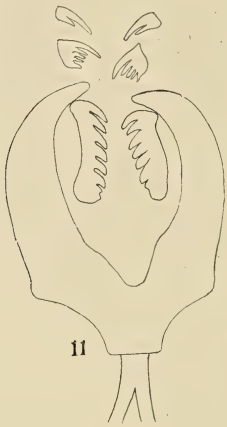


Fig. 10. Posterior dorsal view of *Aracoda attenuata.* ×45.
Fig. 11. Maxillæ of *Aracoda attenuata.* × 185.

Collected in 1909 and 1910 from coral rocks near Fort Jefferson. Type in American Museum of Natural History.

Aracoda spatula n. sp.

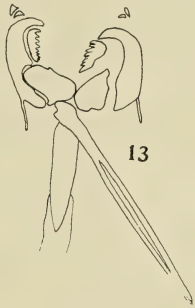
Body slender, 170 mm. long, 2.5 mm. wide at widest part, which is about one quarter of the distance back from the anterior end. Prostomium as broad as first somite, in length equal to rather more than the first two somites, broadly rounded and flattened. No eyes. (Fig. 12.)

Maxillæ black, basal portion elongated into long slender spines (Fig. 13). Left hand plate with about 7 denticulations, that of the right side similar, but with denticulations a trifle stronger. Maxillæ curved uniformly to a blunt point. Terminal plates 2 on either side, triangular, larger on left than on right. The mandible was not seen.

Parapodia of anterior region mere rounded lumps on side of body, but apparently with setæ like those of posterior region. After somite 15, parapodia increase in size up to the 20th, while from here to the posterior end there is very little change, though the posterior ones are the largest in the body. Fig. 14 of a posterior parapodium. Postero-ventrally, a stout lobe overhangs the bases of the tuft of setæ. Setæ 4 or 5, stout, slightly bent, with broad terminal portion, and acute tips. (Only 1 shown in figure.) Most of the broad portion covered with slight protuberances, too irregular to be called denticulations. A single large rounded aciculum barely protrudes from the surface. Each parapodium contains 1 or 2 fine hairlike setæ, usually more or less bent.

No anal cirri were to be seen, though the specimen seemed entire.

According to Ehlers's original grouping of the Eunicidæ, this belongs to the genus *Larande*, following Kinberg, who bases the distinction on the number of plates in the jaw apparatus. In his Florida Anneliden, however,



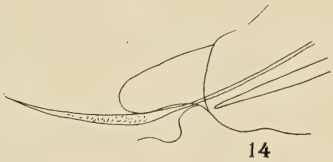


Fig. 12. Head of *Aracoda spatula*. × 7, 5.
Fig. 13. Maxillæ of *Aracoda spatula*. × 7, 5.
Fig. 14. Posterior parapodium of *Aracoda spatula*. × 136.

Ehlers decides that the number of plates may vary, and thus be useless for classification. This species seems to be closely related to *Aracoda debilis*.

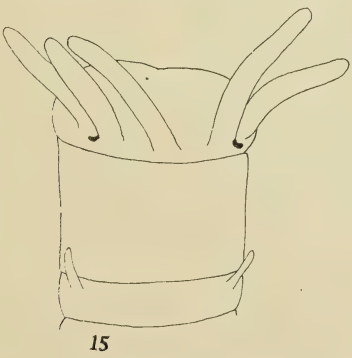
A single specimen, collected from reef near Fort Jefferson, in June, 1909. Type in the American Museum of Natural History.

Nicidion kinbergii *Webster*.

Webster, Annelida from Bermuda. Bull. 25, U. S. Nat. Museum, p. 320.

These agree with Webster's brief description, but since his account is very incomplete I have thought it best to redescribe.

Size small, the largest an incomplete specimen, having a length of 80 mm. with about 150 somites. Greatest width in region of 20th somite, where it is barely 4 mm.



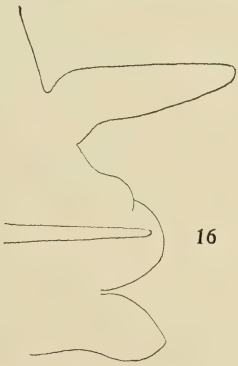


Fig. 15. Head of *Nicidion kinbergii*. × 14.
Fig. 16. Anterior parapodium of *Nicidion kinbergii*. × 68.

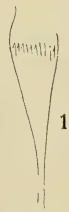
excluding parapodia. Behind region of somite 12 the somites broaden and shorten, becoming much compressed as far back as somite 50. Behind this they narrow a little, and become much longer, the posterior somites equaling in length at least 3 of those in region of somite 50.

Fig. 17. Posterior parapodium of *Nicidion kinbergii*. × 68.

Fig. 18. Simple seta of *Nicidion kinbergii*. × 280.

Breadth of prostomium about equal to twice its length, only very slightly bilobed (Fig. 15). Tentacles relatively rather stout, uniformly tapering to tip, unpaired, extending to middle of somite 3. Inner paired about equal to unpaired in length, outer paired a trifle shorter. Eyes one pair, dark, at base of inner paired tentacles. Peristomium relatively long, equal to more than the combined lengths of 2 and 3. Breadth about equal to $1\frac{1}{2}$ times the length, a little wider at margins than in the middle. Somite 2 less than half the length of 1. Tentacular cirri very short, hardly as long as somite 2. Somites 3, 4 and 5 increasing slightly in length. Prostomium (in alcohol) colorless ventrally, dorsal surface with brown ground color, densely spotted with white. Peristomium and somite 2 pearly white, though former may have a brown tinge with white spots near anterior border. Somites 3, 4 and 5 brown with white spots, 6 and 7 colorless or nearly so, later somites like 3 and 4, but fainter. The amount of this color varies in different animals. Posterior half colorless.

Anterior parapodia with prominent cirri, and single large aciculum (Fig. 16). Dorsal cirrus with a bend near the base, terminal portion tapering to a very bluntly rounded apex, ventral cirrus shorter, ovate from a broad base and rather thick. Throughout anterior third of body a prominent ventral pad on each parapodium. Parapodia of posterior half of body with small dorsal cirrus, while the ventral cirrus practically disappears. Two large aciculæ the dorsal one with rounded end, ventral one with hooked apex covered with a delicate hood (Fig. 17). Both aciculæ dense black except at apex which is colorless. Anal cirri two, short, finger shaped, ventrally placed.



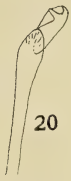


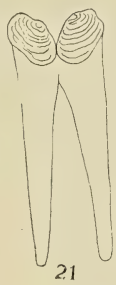
Fig. 19. Comb-shaped seta of *Nicidion kinbergii*. × 280.

Fig. 20. Compound seta of *Nicidion kinbergii*. × 280.

Setæ of 3 sorts. 1. Simple setæ with narrow elongated basal portion, apex suddenly widening and then narrowing again to an acute point. No prominent denticulations or striations on this terminal portion (Fig. 18). 2. Compound, with narrow basal joint, apex provided with minute teeth where it widens to form support for terminal joint. Latter relatively short, with curved apical and straighter subapical tooth (Fig. 20). 3. Comb-shaped setæ, with narrow stalk and 12 to 15 teeth in the flattened end. As noted by Webster, one lateral tooth is longer than the corresponding one on the other side (Fig. 19). All three forms of setæ occur all through the body, 1 and 3 being dorsal to the aciculæ and 2 lying between the two aciculæ. Anteriorly

the comb-shaped setæ are relatively few in number, while posteriorly they form a dense bundle on the dorsal face of the simple setæ.

Mandible (Fig. 21) slender, cutting edges delicate, marked with concentric lines, outer and posterior margins very dark colored. Basal arms light brown, darker along adjacent faces. Maxillæ (Fig. 22) very light colored except that all teeth, the tips and inner faces of the forceps, and a band where the latter join their basal portion, are very dark brown. Forceps slender, slightly curved. First paired plates with 4 teeth, second with 7, left unpaired with 6. Ventral to maxilla is a transparent plate bifurcated so that each half corresponds to half of the jaw apparatus, and with a prominent dark brown spot just anterior to the toothed plates. (Not shown in figure.)



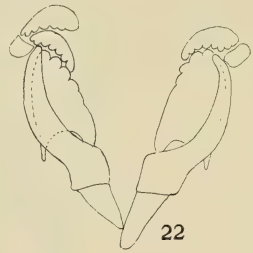


Fig. 21. Mandibles of *Nicidion kinbergii.* × 27.5.
Fig. 22. Maxillæ of *Nicidion kinbergii.* × 27.5.

Found in interstices of coral rock in the vicinity of Fort Jefferson.

Hermenia verruculosa *Grube.*

Grube, Annulata Œrstediana, 1856.

In 1901, in a report on the Annelids of Porto Rico, published in the Bulletin of the U. S. F. C., I described as *Polnoë nodosa* a species having a peculiar rough skin. The specimens in my possession had apparently lost all except the most anterior pair of elytra, an accident not unusual in collecting. The specific name was however, preoccupied, having been used by Sars in 1860, and the species had been previously described by Grube in 1856, as *Hermenia verruculosa.* Grube established the genus *Hermenia* on "Tentacula 3, lateralia nulla. Elytra pari 1mo excepto minutissima." Examination of a considerable number collected in the Tortugas showed that the elytra behind the first pair are present but very small, being hardly larger than the tubercles which cover the surface of the body. (See Fig. 23 for relative size of first and later pairs.) Grube seems to have had a specimen which had lost its palps, since these in my possession are undoubtedly of his species, but have the palps, "Lateral tentacles" of Grube. Since the original diagnosis is very brief, and without figures, I have thought it wise to publish a redescription.

Head rounded, prolonged anteriorly into bases of antennæ, with breadth a trifle less than distance from posterior margin to bases of antennæ. Eyes laterally placed, scarcely visible from dorsal surface. Ceratophore of median tentacle about $\frac{1}{3}$ as long as head. Median tentacle (Fig. 23) long, slender, when folded back extend-

ing beyond posterior margin of head. A subterminal swelling with filamentous tip. Lateral tentacles rather more than half as long as median, but similar in form. Tentacular cirri about as long as median tentacle. Palps long, tapering at first, and then more rapidly to an acute tip. Palps, tentacles, and tentacular cirri with a general ground color of brown with subterminal swelling white, and a varying amount of white along the stalk.

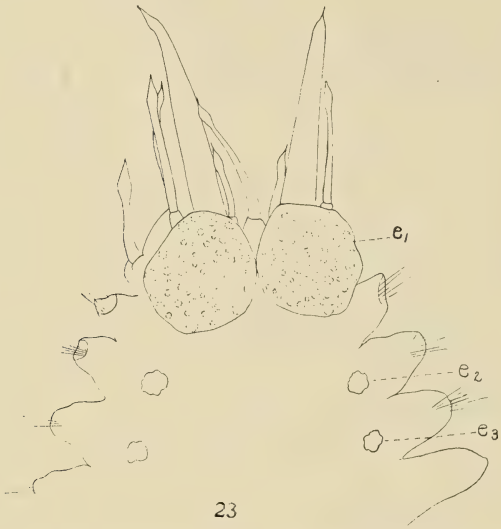


Fig. 23. Anterior dorsal view of anterior end of *Hermenia verruculosa* to show relative size of 1st (e_1), 2nd (e_2), and 3rd (e_3) elytra. The surface tubercles of the skin are not shown. × 6, 5.

Proboscis 4.5 mm. long in a specimen of 20 mm. Surface of proboscis smooth, with a variable number, 7 to 11, of papillæ fringing the edge of each lip. In the mouth are two large brown horny teeth, above and below, which interlock when the mouth is closed.

On either side of these large teeth is a small black cutting surface running laterally from the outer edge of the tooth.

Coloration of dorsal surface variable. There is a ground color of white or cream, and it is thickly studded with tubercles, the coloration depending on the color and arrangement of these. Most of the tubercles are dark brown, those on cirrus-bearing somites being lighter in color than those on somites with elytra. As a result the somites appear alternately light and dark. In most cases, the 4th setigerous somite shows more or less white. The entire dorsal surface may have this color, or it may appear as a median and two lateral patches, with a narrow brown patch on either side between. Somites 3, 2 and 1 show each a mid dorsal patch of white, relatively narrowing from behind forward, so that with the patch on the 4th somite the whole forms a triangular area with the apex at the anterior end. Variations may appear in the direction of an entire patch of white over the dorsal surfaces of the first 4 somites, or on the other hand this entire area may be dark, in which case it is the darkest portion of the body. There is usually a median row of white papillæ running along the mid dorsal line, much the most prominent toward the posterior end. Ventral surface creamy white, with numerous papillæ giving it a villous appearance. Nephridial papillæ are very prominent, especially toward the posterior end.

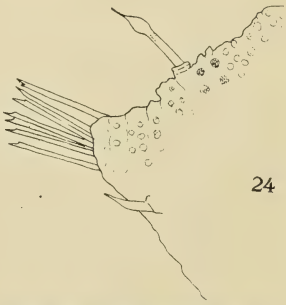


Fig. 24. Parapodium of *Hermenia verruculosa.* × 13.

Parapodia stout, more or less wrinkled, and thickly covered with tubercles (Fig. 24).

No notopodial setæ. Neuropodial setæ stout with bifid apex (Fig. 25), about 13 in a bundle. First elytron nearly rectangular in outline, and covered with tubercles (Fig. 23). The edge bears a fringe of narrow finger-shaped processes, not shown in figure because not visible under the magnification employed. The elytra of later somites are shown on same scale as the first in Fig. 23, and under greater magnification in Fig. 26. They are roughly oval in outline, with edge carrying a number of relatively thick finger-shaped processes. On the dorsal surface from four to six large, dark, hard tubercles.

25

Fig. 25. Seta of *Hermenia verruculosa.* × 156.

Length of a medium sized specimen 30 mm. Width of middle somite of body, including parapodium, 7 mm. From middle region the body narrows slightly toward both anterior and posterior ends. Number of somites 26, with 12 pairs of elytra on somites 1, 3, 4, 6, etc.

26

Fig. 26. Small elytron of *Hermenia verruculosa.* × 150.

The specimens from the Tortugas were found living in interstices in the coral rocks moving into deeper crevices with considerable rapidity when disturbed, and clinging with great tenacity to the rock, so that it is often difficult to get them off without injury. A single specimen was collected at Andros in the Bahamas in 1908. Grube records it from "St. Jan," and, as noted above, it was collected by the U. S. F. Commission in Porto Rico. It apparently, therefore, has a wide distribution throughout the West Indies.

Streblosoma verrilli n. sp.

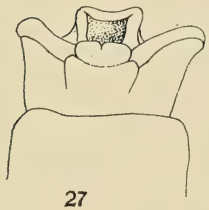
Prostomium inconspicuous, forming a horseshoe-shaped lip overhanging the mouth. Tentacles slender, elongated, half as long as the body. Peristomium (Fig. 27) with a thickened collar-like edge, not drawn out into lobes, having a shallow median dorsal depression, and ventrally a small lower lip, the latter partly divided into two lobes by a medial depression. Outer surface of peristomium with a dense accumulation of dark pigment spots (ocelli). No lateral lobes on somites posterior to head.

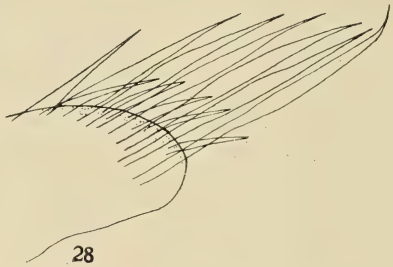
At least the first 33 somites with capillary setæ borne on prominent papillæ. Body of uniform diameter to about 25th to 32nd somite, where it narrows to barely

half the diameter of thorax. From somite 32 it narrows gradually to an acute tip. Only one specimen was complete and this had the entire posterior end of body filled with eggs. Ventral face of thorax with 17 shields, the last three narrower than the others. Uncini extend through greater part of the body, apparently to extreme posterior end.

Gills cirriform, in clusters on somites 2, 3, and 4. In the specimens in my possession, 5 was the largest number in any one cluster, while the specimen best preserved in other respects had only 2. Gills twice as long as transverse diameter of body.

Setæ in each parapodium, beginning on 1st branchial somite, borne on a prominent papilla, arranged in a single row. Setæ of two kinds (Fig. 28). One form large, with stout shaft, broadened for the terminal two thirds, tapering rather abruptly





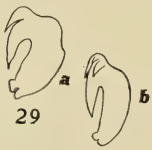


Fig. 27. Head and somite 1 of *Streblosoma verrilli.* × 13.
Fig. 28. Seta of 25th somite of *Streblosoma verrilli.* × 65.
Fig. 29*a* and *b*. Uncinus of *Streblosoma verrilli.* × 280.

to an acute tip. Under high power, the whole seta shows numerous oblique striations. Second form much shorter, more nearly transparent, with acute tip. The two are arranged alternately in a single row on the end of the papilla.

Uncini begin on 3rd branchial somite, in a single row of about 30. This single row condition persists throughout the body, though the number in the row increases toward the middle portion. Uncinus with stout base, with a knob. A single large hook above, with two smaller hooks at the base. Between these a third, smaller hook. (Fig. 29*a*, profile; 29*b*, $\frac{3}{4}$ face view.)

No tubes were found.

Length of body, 90 mm. with greatest breadth of thorax 7 mm. in a specimen having 160–170 somites.

Collected from reef near Fort Jefferson, June, 1909. Type in American Museum of Natural History.

Vassar College, Jan., 1911.

59.7,55M

Article II.—NOTES ON LANTERN FISHES FROM SOUTHERN SEAS, COLLECTED BY J. T. NICHOLS IN 1906.

By Charles H. Gilbert.

Myctophum antarcticum (*Günther*).

One specimen, 55 mm. in total length, 44 mm. to base of caudal fin; locality approximately 39° S. Lat., 79° W. Long., about 400 miles southwest of Valparaiso, Chile. The locality is thus near that of Lütken's larger specimen of *Scopelus colletti* (about 600 miles west of Cape Horn), from which he largely drew the description of the species. The present specimen agrees much more closely with Lütken's figure and description (Spolia Atlantica, *Scopelini*, pp. 249–250, fig. 7) than with Brauer's (Deutsche Tiefsee-Expedition, XV, pp. 168–170), but all descriptions are so seriously lacking in detail that it is impossible to determine whether Brauer was justified in ranging *M. colletti* in the synonymy of *M. antarcticum*, or whether the species is distinct.

The following notes on the distribution of photophores in our specimen will be useful for further comparisons.

Thoracics 5, the anterior not concealed as figured by Brauer, all the thoracics more posteriorly placed; thus the second is only slightly in advance of the line joining the suprapectoral with the lower subpectoral, the third is vertically beneath the upper subpectoral, the fourth is near the base of the ventral fins, and the fifth is crowded out at the side, distinctly elevated, its lower margin slightly above base of ventrals. First four pairs of thoracics equally spaced; photophores of the first pair closely approximated on median line, those of second, third and fourth pairs equally and more widely separated from their fellows. According to Brauer, the thoracics are all "auf gleicher Höhe"; Lütken finds the "sidste Par rykkede lidt mere ud fra hinanden."

The ventral photophores are also said by Brauer to be equally elevated, while according to Lütken, the first and fourth pairs are a little nearer each other than the others. In our specimen, those of the first pair lie immediately behind and mesad to the base of inner ventral ray, and are almost in contact with each other on the median line; the second and third pairs are much farther from the ventral line, about on the level of the outer ventral rays; those of the fourth pair again more closely approximated, at either side and slightly in advance of the vent.

Anals 15, in three distinct groups: the first includes the first 2 photophores, which lie nearer the base of the anal fin than do the others, and are separated by a wider space from those which follow; the middle group contains 9, arranged in a slight ~ -shaped curve, the anterior and middle spots nearest the base of the fin, the posterior gently diverging; the third group contains the posterior 4, which lie in parallel lines behind the anal fin, and are distinctly nearer the median line than are

any of the middle group; they undoubtedly represent the postero-anals of other species. Precaudals 2, well separated from the anal series, in a horizontal line above rudimentary caudal rays.

Suprapectoral much smaller than the subpectorals, inserted in front of upper subpectoral and slightly below its level; the line joining suprapectoral and lower subpectoral passes through the second thoracic (not the third as in Brauer's figure).

Supraventral slightly nearer lateral line than base of ventral fin; a line joining supraventral and 5th thoracic passes almost directly through 4th thoracic also.

Supra-anals more angulated than shown in Brauer's figure, the 2nd a little lower than the 1st, the latter on a level with the supraventral; a line joining the second supra-anal and the upper subpectoral passes along the lower margin of the supraventral and the 1st supra-anal; 3rd supra-anals immediately below the lateral line, the line joining 2nd and 3rd supra-anal passing through the 4th ventral; space between 2nd and 3rd supra-anal but $\frac{2}{3}$ that between the 1st and 2nd, the 1st equidistant between the 2nd and the supraventral. A distinct photophore at base of adipose fin.

D. 13; A. 19; V. 8; Lat. l. 39.

Myctophum affine (*Lütken*).

One specimen, from approximately 1° S., 118° W., typical of the species in all respects. The anal photophores are 8 + 6 in number on each side, a number which occurs rarely about the Hawaiian Islands, but apparently grows more common south of the equator.

Myctophum humboldti *Risso.*

A single specimen, 42 mm. in total length, off the coast of Chile, approximately 39° S., 79° W.

The variations in number and position of photophores reported by Brauer (Deutsche Tiefsee Expedition, XV, 1906, p. 193, figs. 108–111) on the basis of the Valdivia material, seem excessive for a single species. The figures apparently represent 4 of the 10 specimens secured by the expedition, although closer indication of their locality has been omitted. I have compared our single specimen with 4 of those reported on by Lütken (Spolia Atlantica: *Scopelini*, 1892, p. 254, fig. 12) from the vicinity of Cape Horn and find agreement in all important respects, without more variation than is commonly found in other species of the genus. In all, the antero-anals are distinctly arched, the line joining the 2nd and 3rd supra-anals passes immediately in front of the 4th ventral, the supraventral and the first 2 supra-anals are approximately in the same straight line and equally spaced, the 1st supra-anal is over or very slightly in advance of the 2nd ventral, and the precaudals are obliquely inserted on the base of the lower caudal

lobe. In our specimen, the anals are 9 + 6 on one side, 8 + 7 on the other, the posterolateral is above the last antero-anal in each case, hence more anterior in position on one side than on the other; the posteroanals are in pairs and opposite, the odd one on the side with 7 being anterior in position, obviously corresponding to the posterior odd anteroanal of the opposite side. First three pairs of thoracics are equally spaced and form two series regularly diverging backwards; space between 3rd and 4th thoracics much shorter than the preceding interspaces, the 4th pair closely approximated; 4th interspace a trifle longer than 3rd, those of the 5th pair again farther apart, at base of outer ventral rays. First pair of ventrals mesad to base of inner ventral rays, succeeding pairs somewhat farther separated and equally so, the distances between the pairs equal.

Dasyscopelus spinosus (*Steindachner*).

A single specimen, 44 mm. long, from approximately 1° S., 118° W. The anal series of photophores are 7 + 7 in number, the anterior group gently arched; the precaudals are a little more widely spaced than the anal series, the posterior a little higher than the anterior; the supra-anals are in a straight oblique line; the long pectorals reach to the vent; the series of scales which cover the anal photophores have already developed the row of stronger spines so characteristic of adults.

Rhinoscopelus tenuiculus (*Garman*).

Twelve specimens, 35 to 50 mm. long, were taken Nov. 27 and 28, 1906, approximately at 1° S., 118° W., nearly midway between the Galapagos and the Marquesas Islands, and one specimen to the north of this point, at approximately 8° N., 119° W. But two specimens had been placed on record hitherto, the type from the vicinity of Panama and a second specimen from 10° 57′ 35″ W., southeast of the Hawaiian Islands.

In his preliminary review of the Myctophids of the Valdivia Expedition (Zool. Anz., 1904, 28, p. 390), Brauer has arranged this species in the synonymy of *R. coccoi*, and in his final report (Die Tiefsee Fische, 1906, 194 and 196), he identifies it with *Myctophum hians* Richardson. Neither position is correct. As has been shown by the writer (Mem. Mus. Comp. Zool., 1908, 26, p. 222), *tenuiculus*, while closely allied to *coccoi*, is well distinguished by the reduced number of ventral rays, the shorter anal and the differing proportions of head and body. In *R. tenuiculus*, the ventrals contain but 7 rays, while in *coccoi* there are invariably 8. This distinction holds in the two specimens of *tenuiculus* previously reported on, the thirteen speci-

mens of the present collection, and in six specimens from near the Galapagos Islands, to which we have had access. Of *coccoi,* we have examined seven specimens of the Lütken material, five of these from the mid-Altantic and two from the Indian Ocean; and nineteen specimens from the western Atlantic off Cape Hatteras. All have 8 ventral rays, and the anal rays vary from 20 to 23, as follows: 20 in 3 specimens, 21 in 15 specimens, 22 in 6 specimens, 23 in 2 specimens. In *tenuiculus,* the number of anal rays varies from 18 to 20, as follows: 18 in 7 specimens, 19 in 13 specimens, 20 in 1 specimen.

The antero-anal photophores agree in the two species, ranging in our material from 5 to 7, with 6 the prevailing number and 7 rare. In correspondence with the longer anal fin in *coccoi,* the postero-anals are more numerous in that species and more of them are located in advance of the last anal ray. Thus in *coccoi,* the postero-anals are 11 in 8 specimens, 12 in 11 specimens, 13 in 7 specimens; the numbers in advance of last anal ray are 5 in 3 specimens, 6 in 16 specimens, 7 in 7 specimens. In *tenuiculus,* the postero-anals are 10 in 4 specimens, 11 in 11 specimens, 12 in 4 specimens, and those in advance of last anal ray are 4 in 11 specimens, 5 in 8 specimens.

While it is recognized that the number of specimens at our disposal is not adequate to discover the total range of variation in the two species, it is proper to call attention to the fact that Brauer's material extended over the known range of both species. It is possible therefore, that the extreme variation assigned by Brauer may be due in part to his failure to differentiate the two forms.

Centrobranchus andreæ (*Lütken*).

A fine specimen, 50 mm. long to base of caudal fin, was taken by Captain W. L. Josselyn, southwest of Tahite, 24° S., 152° W. Both Lütken and Brauer have failed to note the obsolete lateral line and the undeveloped gill-rakers in this species, characters in which it agrees with *C. chærocephalus,* and which differentiate these two species sharply from all other known forms including *Rhinoscopelus coccoi.* Lütken's description was based on material which included two distinct species, the specimens I have been privileged to examine not being typical of *andreæ.* Having no material for comparison, I accept provisionally Brauer's identification of *C. gracilicaudus* with *andreæ.*

Our specimen has the 3 supra-anals in an almost straight line, the first only a trifle advanced, the line passing just cephalad of the fourth ventral; supra-anals 6 + 11, three of the posterior series overlapping the anal fin; back of caudal peduncle with 8 conspicuous phosphorescent scales, not at all confluent.

Scales somewhat irregularly arranged, the mid-lateral series enlarged, wholly lacking the longitudinal ridge which in *R. coccoi* marks externally the position of the tube of the lateral line. Scales from the mid-lateral series when detached and examined under a lens appear wholly wanting in tube or pore; examined superficially, an occasional lighter spot along the series may simulate a pore.

Outer gill-arch with 4 or 5 low tubercles on horizontal limb, wholly lacking the long slender gill-rakers present in *Rhinoscopelus coccoi*. That this is indicative of different food habits in the two genera is made additionally probable by the extreme development of the teeth in *C. andreæ*. The jaws and the palatines are not specialized in this respect, but the pterygoid has a broad tooth-bearing surface covered with strong conical teeth in several rows. The pharyngeals are even more developed, the upper pharyngeals forming salient masses at the back and sides of the pharynx, extending laterally in front of the posterior gill arches, which are somewhat displaced thereby.

Lampanyctus nicholsi sp. nov.

Type 57 mm. long, taken by Mr. J. T. Nichols, Oct. 15, 1906, at approximately 47° S., 60° W., a short distance north of the Falkland Islands.

Not closely related to any known species, being sharply distinguished by the insertion of both subpectorals on the level of the base of the pectoral fin, by the presence of 6 thoracic and 5 ventral photophores, none of which is elevated, and by the presence of 6 precaudals sharply set off from the postero-anals.

Measurements in hundredths of total length without caudal: length of head 31; diameter of eye 8.5; axial length of snout 5; length of maxillary 23.5; greatest depth of body 17; least depth of caudal peduncle 9; distance from tip of snout to origin of dorsal 44; length of base of dorsal 20; distance from snout to adipose dorsal 76; to insertion of ventrals 46; to front of anal 60; length of base of anal 20; length of pectoral 13; length of ventral 17.5; length of longest gill-raker 7; longest dorsal ray 25.

Dorsal 18, the first 3 rays shortened; anal 20, the first 2 shortened; ventral 9, the outer ray shortened, rudimentary; pectoral 13; lateral line 42; gill-rakers very long and numerous, 10 on vertical limb of outer arch, 22 on horizontal limb.

Head as well as trunk very slender; snout short, vertically rounded; maxillary very long, its middle under posterior margin of orbit, not widened posteriorly; preopercle very oblique, the vertical diameter of cheek but two-thirds its greatest oblique diameter.

Pectoral fin inserted low, its upper ray on level of lower line of orbit; the longest pectoral ray reaches base of ventral. Ventrals extending to base of second or third anal ray. First dorsal ray slightly in advance of vertical from base of ventrals, the last ray over the second or third of the anal. Front of adipose over last anal ray. The scales have all fallen.

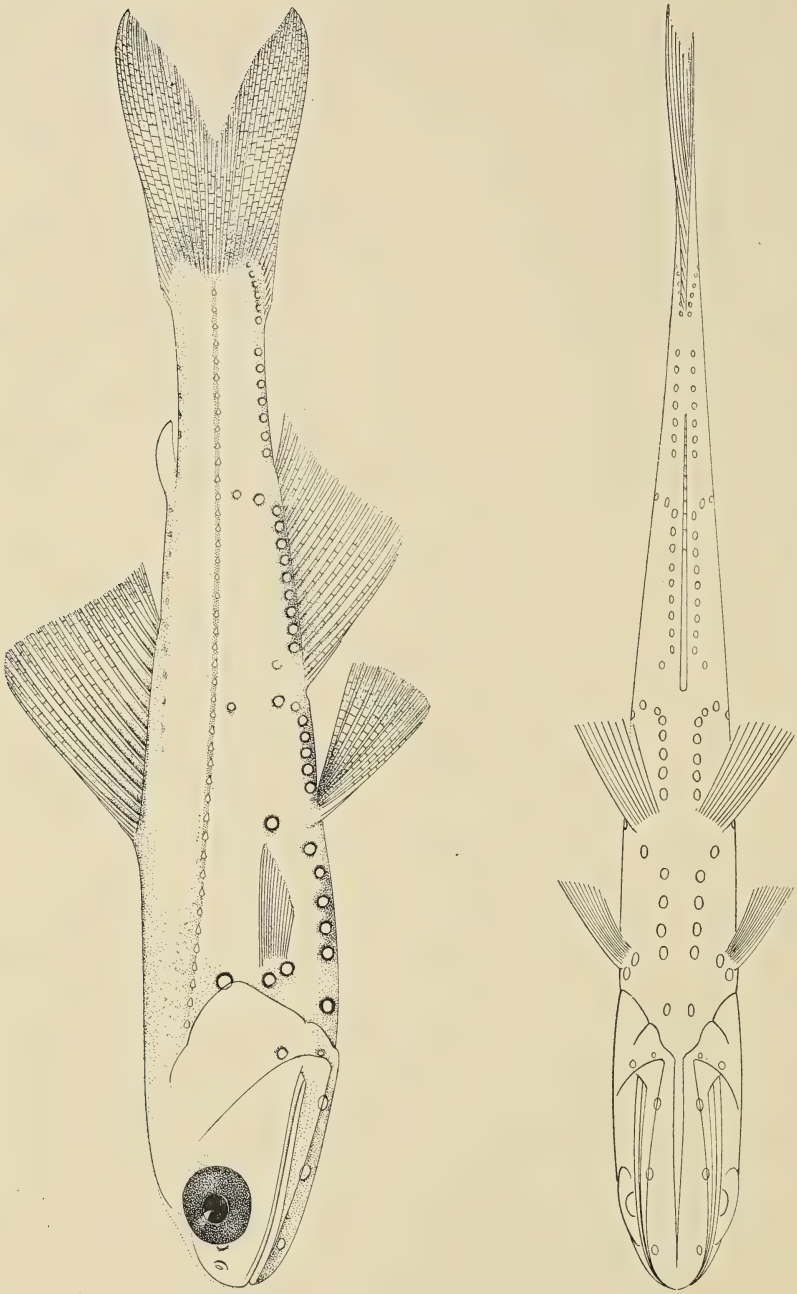


Fig. 1. *Lampanyctus nicholsi* sp. nov.

Photophores: a small antorbital between orbit and lower part of nostril; 3 branchiostegals; 2 under the preopercle, placed low, the upper on level of lower part of cheek, much larger than the lower, which is inserted on level of mandibular joint.

Suprapectoral a trifle nearer lateral line than base of upper pectoral ray; both infrapectorals on level of base of pectoral fin, the upper above and in advance of the lower, the two nearly in contact.

Thoracics 6, none elevated, the first and second pairs near the median line, the third and fourth gently diverging the fifth again slightly approximating, the sixth more widely diverging, on level with the outermost ventral rays; interspace between first and second pairs twice the width of succeeding interspaces, which are approximately equal.

Supraventral low, its distance from base of ventrals half its distance from lateral line.

Ventrals 5, closely and equally spaced, and on a level.

Supra-anals 3, the lowest continuous with the ventral series and only a trifle higher; the uppermost near the lateral line and vertically above the vent or the interval between vent and first anal ray; the middle one vertically below the upper, or below and slightly behind it, midway between upper and origin of anal fin. The supra-anals are slightly angulated, as the lowermost is below and slightly in advance of the middle one.

Antero-anals 10, separated by a wide interspace from the postero-anals; first antero-anal elevated, as in *L. braueri*, this being exceptional in the genus; it is on a level with the middle supra-anal, and lies in a straight line connecting upper supra-anal with second antero-anal; the second to the tenth antero-anals form a straight line parallel with base of anal fin, the tenth opposite base of 16th anal ray.

Posterolaterals 2, in an oblique line which passes behind the last antero-anal, the upper immediately below the lateral line.

Postero-anals 7, the two series forming straight parallel lines, wholly behind the anal fin, separated by wide spaces from the antero-anals and from the precaudals.

Precaudals 6, equally spaced and close-set, in a gently curved line above base of lower caudal rays, the anterior one opposite base of first rudimentary ray, the posterior one much nearer lower profile than lateral line.

Integument largely abraded in all specimens; the remaining patches seem to indicate the general color as dark slate; opercles jet-black. No traces remain of luminous scales. A series of very large chromatophores, one to each scale, occupies the second series of scales below base of dorsal, and extends from below middle of dorsal backward, converging to base of adipose fin, and from there in a double series to origin of upper caudal lobe.

In addition to the type, three specimens 60 to 65 mm. long, here designated as cotypes, were taken at the same locality as the type.

Named for the discoverer of the species, John Treadwell Nichols.

59.57,96(729.2)

Article III.— ADDITIONS TO THE ANT-FAUNA OF JAMAICA.[1]

By William Morton Wheeler.

On the basis of a collection made during the winter of 1905–'06 by Mr. Alexander E. Wight of Wellesley Hills, Mass., I published in 1908 a list of the ants of Jamaica.[2] In this list, in which I included all the species previously described from the island, only forty forms were enumerated. Mr. Wight has now sent me a second and even larger collection which he made during 1909 in a different part of Jamaica, and Dr. Michael Grabham and Prof. E. A. Andrews have recently supplied me with a number of specimens from Kingston. These collections, now belonging to the American Museum, contain twenty-one additional forms, indicated by asterisks prefixed to their respective names in the following pages. The total number of Jamaican ants known at the present time is therefore sixty-one, which is almost as many as are known to occur in Porto Rico and the Virgin Islands. These additions to the Jamaican fauna, however, contain only two new species, both belonging to the genus *Pheidole*, but one of these must be referred to the very interesting subgenus *Ceratopheidole*, of which only two species have been described: *C. granulata* Pergande, of Mexico, and *C. smythiesi* Forel, of India. The remaining nineteen forms are, with few exceptions, widely distributed over tropical America.

Family FORMICIDÆ.

Subfamily Ponerinæ.

1. **Ectatomma (Holcoponera) strigatum** (*Norton*).— Several workers and two poorly preserved males from two colonies from Balaclava (Wight).

2. ***Ectatomma (Gnamptogenys) interruptum** *Mayr.*— Numerous workers from a single colony "nesting under bark of a log where some soil had accumulated"; Mandeville (Wight).

3. **Platythyrea punctata** (*F. Smith*).— Several workers from Balaclava and Mandeville (Wight).

4. ***Pachycondyla harpax** (*Fabr.*).— Four workers of the typical form from Balaclava (Wight).

---

[1] Contributions from the Entomological Laboratory of the Bussey Institution, Harvard University. No. 35.

[2] The Ants of Jamaica. Bull. Amer. Mus. Nat. Hist. XXIV, 1908, pp. 159–170.

5. ***Anochetus mayri** *Emery* subsp. **læviusculus** subsp. nov.

Differing from the typical *mayri* in the less deeply sculptured surface of the body in both female and worker, the pronotum and head, except the vertex, being smoother and distinctly shining. The petiole is clearly bicuspidate; the transverse impression of the epinotum as in the typical form and not feeble as in the Brazilian subsp. *neglectus* Emery. The color of the body of the worker is somewhat paler and more yellowish than in the typical *mayri*; the size averages a little less (female 3.5 mm.; worker 3 mm.). Described from ten workers and one female taken near Troy (Wight).

6. **Odontomachus hæmatodes** (*L.*).— Workers, males and winged females from several colonies taken near Troy and at Balaclava (Wight).

7. ***Odontomachus hæmatodes** var. **hirsutiusculus** *F. Smith.*— Workers and males from Balaclava, Mandeville and Kingston (Wight) and workers and a winged female from Moneague (F. C. Paulmier) are smaller than the corresponding phases of *O. hæmatodes in. sp.* and the workers and females are more hairy and pubescent. This form is certainly very closely related to the subsp. *insularis* Guérin.

8. ***Ponera fœda** *Forel.*— Two workers taken from rotten wood near Troy (Wight).

9. ***Ponera opaciceps** *Mayr.*— Several workers "nesting in refuse from sugar-cane mill near Troy" (Wight).

Subfamily Myrmicinæ.

10. **Pseudomyrma delicatula** *Forel.*— Workers from several colonies taken at Troy, Mandeville and Balaclava (Wight). This form is scarcely distinct from *Ps. flavidula* F. Smith.

11. **Pseudomyrma elongata** *Mayr.*— Workers from Troy and Balaclava (Wight) and Kingston (Grabham).

12. ***Pseudomyrma gracilis** (*Fabr.*).— Numerous workers from Balaclava (Wight), all representing the same color variety, being black with the thorax, petiole, clypeus and mandibles clear reddish yellow, the tarsi brown.

13. **Monomorium destructor** (*Jerdon*).— Several workers from Kingston (Grabham).

14. **Monomorium floricola** (*Jerdon*).— Numerous workers from Kingston (Grabham) and Bowden (Wight).

15. **Monomorium carbonarium ebeninum** *Forel.*— Workers from

Kingston (Grabham); workers and females from Mandeville and Balaclava (Wight).

16. **Cardiocondyla emeryi** *Forel.*— Several workers from Balaclava and Troy (Wight).

17. **Solenopsis geminata** (*Fabr.*).— Numerous specimens of all three phases of the typical dark form of the species from Troy and Balaclava (Wight), and Kingston (Grabham and Andrews).

18. ***Solenopsis azteca** *Forel.*— Several workers from Mandeville (Wight) agree closely with a type specimen of this species from St. Vincent in my collection.

19. **Solenopsis azteca** var. **pallida** *Wheeler.*— Numerous workers from Mandeville and Balaclava (Wight).

20. ***Solenopsis hammari** *Mayr* ? — A few workers from Mandeville (Wight) agree very closely with Emery's figure of this species (Bull. Soc. Ent. Ital., XXXVII, 1905, fig. 11) and probably belong either to it or to a dark subspecies of *S. decipiens* Emery. The antennal scapes are rather short and the clypeal teeth stout as in *hammari,* but the shape of the epinotum in profile is more like that of *S. decipiens* subsp. *abjecta* Emery, *i. e.*, with a more pronounced mesoëpinotal constriction than in *hammari.* The specimens measure about 1.5 mm. and are dark brown, with the mandibles, legs and gaster, except the first segment, yellow.

21. **Pheidole fallax** *Mayr.*— Soldiers and workers from several colonies; Balaclava (Wight); Kingston (Wight and Grabham).

22. **Pheidole megacephala** (*Fabr.*) — Soldiers and workers from Mandeville (Wight) and Kingston (Grabham).

23. **Pheidole subarmata** *Mayr.*— Soldiers and workers from several colonies; Balaclava (Wight).

24. **Pheidole radoszkowskii** *Mayr* var. **opacissima** *Forel.*— A few workers from Kingston (Grabham) agreeing very closely with topotypes received from Prof. Forel.

25. ***Pheidole caribbæa** sp. nov.

Soldier. Length 3.5–4.3 mm.

Head rather small, without the mandibles a little longer than broad, as broad in front as behind, convex above and below, with rounded sides and posterior corners and rather deep, angular occipital excision, which is continued forward over the vertex as a well-defined median groove to the frontal area. Eyes moderately large, convex, in front of the middle of the sides of the head. Mandibles convex, with two stout apical and no basal teeth. Clypeus short, flattened and ecarinate in the middle, its anterior border with a median excision. Frontal area subtriangular, rounded behind, as long as broad, impressed, without a median carinula. Frontal

carinæ short. Antennæ slender; scapes curved but not flattened at the base, reaching nearly to the posterior corners of the head; club as long as the remainder of the funiculus, its terminal joint a little longer than either of its subequal basal joints; all the remaining funicular joints distinctly longer than broad. Thorax rather slender, as long as the head and half as broad, a little broader in front than behind, with rounded humeri, lacking the tubercles. In profile the pronotum is convex and rounded and separated by a narrow transverse constriction from the mesonotum which is transversely convex and separated by a still deeper and broader constriction from the epinotum. Base of epinotum longer than the declivity, the former horizontal and feebly convex, the latter sloping and somewhat concave; spines small, slender, subparallel, rather blunt, longer than broad at their bases, further apart than long and directed upward at right angles with the base of the epinotum. Petiole slender, seen from above a little broader behind than in front, about three times as long as broad, its sides feebly concave; in profile the node is very low and angular, with long and somewhat angularly concave anterior and very short and rather straight posterior surface. Postpetiole small, nearly as long as broad, about half again as broad as the petiole, subrectangular, somewhat broader in front where it is obtusely angular on each side. Gaster elliptical, distinctly smaller than the head. Legs long and slender.

Mandibles, clypeus, frontal area and occipital groove shining; the mandibles finely and very sparsely punctate, the clypeus longitudinally rugulose. Remainder of head opaque, except the extreme posterior corners which are shining in some specimens; upper surface and sides rather densely longitudinally rugose, with finely and densely punctate interrugal spaces. Antennal foveæ concentrically rugose. Thorax, petiole, postpetiole and basal half of first gastric segment opaque, finely and densely punctate, the pronotum also with a number of transverse rugæ. Legs and remaining portions of gaster smooth and shining. Antennal scapes subopaque.

Hairs gray, moderately long, abundant on the head and thorax, sparser on the gaster; suberect or more or less appressed on the body and scapes; on the legs shorter and oblique.

Black or dark piceous brown; mandibles and clypeus ferruginous, bordered with black; head often ferruginous above but in most specimens concolorous with the thorax; scapes dark brown; funiculi, tarsi and articulations of the legs yellowish.

Worker. Length 2–2.5 mm.

Head elliptical, without the mandibles a little longer than broad, distinctly narrowed and constricted at the occiput which is marginate. Eyes near the middle of the sides. Mandibles slender, with two small, acute apical and a few minute and indistinct basal teeth. Clypeus convex, with rounded, entire anterior border. Antennal scapes slender, reaching half their length beyond the occipital border of the head. Thorax and petiole similar to those of the soldier, but the epinotal spines are shorter and the promesonotal constriction feebler. Postpetiole nearly spherical, but little broader than the petiole. Gaster about the same size as the head. Legs long and slender.

Mandibles, frontal area and front smooth and shining; remainder of head, thorax, petiole, postpetiole and base of first gastric segment opaque, finely and densely punctate; legs, antennæ and tip of gaster shining.

Hairs similar to those of the soldier but much less abundant and conspicuous and less appressed on the head and thorax.

Black or deep piceous brown; mandibles, tarsi and antennal funiculi yellow or reddish; mandibular teeth blackish; legs and antennæ, especially the funiculi, often brown or reddish.

Female. Length 5.5–6 mm.

Head resembling that of the soldier but with nearly straight posterior border and more angular posterior corners. Antennal scapes reaching a little beyond the posterior corners. Eyes large. Thorax robust, with flattened mesonotum and scutellum. Epinotum with short, stout spines; its base and declivity subequal and forming together a single abruptly inclined surface. Petiole and postpetiole robust, the former in profile with a high, acute node near its posterior end, the latter from above transverse, nearly twice as broad as long, with pointed sides and rounded anterior border. Gaster suboblong.

Sculpture of head similar to that of the soldier. Thorax opaque, very finely punctate, with longitudinally rugose mesonotum and pleuræ, a smooth, shining anteromedian mesonotal spot and parapsidal furrows. In one specimen the mesopleuræ are also rather smooth and shining. Scutellum coarsely punctate, shining. Epinotum coarsely rugose; petiole, postpetiole and nearly the whole of the first gastric segment opaque and densely punctate; postpetiole above transversely rugose; posterior border of first gastric and whole of remaining segments smooth and shining.

Pilosity similar to that of the soldier but proportionally shorter and on the gaster more abundant.

Black; mandibles and clypeus, except their borders, front of head, cheeks, antennal scapes and femorotibial articulations ferruginous. Tarsi yellow. Wings grayish hyaline, with pale yellowish veins and stigma.

Male. Length 3–3.5 mm.

Integument very soft and pliable. Head small, through the eyes as broad as long, produced and narrowed behind; cheeks lacking. Eyes and ocelli large and convex. Mandibles bidentate. Antennæ filiform, scape but little longer than the first funicular joint, which is swollen and distinctly longer than broad. Clypeus convex in the middle, with entire, broadly rounded anterior border. Thorax robust, much broader than the head. Epinotum sloping, unarmed, without distinct base and declivity. Petiole and postpetiole similar to those of the worker, but the former with lower, more rounded node. Gaster and legs slender.

Head opaque, very finely and densely punctate, remainder of body smooth and shining.

Hairs pale yellow, short, suberect, rather abundant both on the body and appendages.

Head black above; thorax and gaster brown, except the sutures and articulations, which together with the mouthparts, antennæ and legs are pale, sordid yellow. Wings colored as in the female.

Described from numerous soldiers, workers and males and two females taken by Mr. Wight from several nests at Mandeville, Balaclava and Troy. According to notes accompanying the specimens the colonies of this species are "very populous, active and aggressive and nest in moist black soil under stones or in rotten logs."

Ph. caribbæa evidently belongs to the group of *Ph. radoszkowskii* Mayr and *biconstricta* Mayr. In the proportions and shape of the head of the soldier it resembles *radoszkowskii* but the thorax is less thickset and more like that of *biconstricta.* From both species the Jamaican form differs in its pilosity and sculpture and in the shape of the head of the worker which is elliptical in outline, constricted and marginate behind and neither subrectangular, nor with a transverse occipital border and distinct posterior corners.

26. ***Pheidole flavens** *Roger* var. near **thomensis** *Emery.*— Several soldiers and workers taken from a single colony nesting in the ground under a stone at Mandeville (Wight) are intermediate between the var. *vincentensis* Forel and the var. *thomensis* Emery, the color and the form of the pro- and mesonotum of the soldier being more as in the former, the shape of the epinotum and its spines as in the latter variety.

27. **Pheidole punctatissima jamaicensis** *Wheeler.*— Soldiers and workers from several colonies taken near Troy (Wight).

28. ***Pheidole** (**Ceratopheidole**) **hecate** sp. nov.

Soldier. Length 3.5–4 mm.

Head rather small, subrectangular, without the mandibles very nearly as broad as long, as broad in front as behind, with feebly convex sides, feebly excavated posterior border and rounded posterior corners. Vertical groove shallow and indistinct. Eyes moderately large, convex, situated about $\frac{1}{3}$ the distance from the anterior to the posterior corners. Mandibles convex, with two large apical and two minute basal teeth. Clypeus short, convex in the middle, with a broad but shallow median excision in its anterior border. Frontal carinæ short. Frontal area rather feebly impressed, subtriangular, rounded behind, as long as broad. Antennæ 12-jointed, rather slender, scapes reaching nearly to the posterior corners of the head, curved and a little flattened at the base. Funiculus with a 4-jointed club, the three basal joints of which are subequal and each half as long as the terminal joint; first funicular joint as long as the three succeeding joints together, joints 2–7 subequal, but little longer than broad. Thorax rather robust, especially in front; as long as the head excluding the mandibles and half as broad. Humeri distinctly tuberculate. Pro- and mesonotum fused and somewhat flattened above, not separated by a transverse suture or constriction; mesoëpinotal constriction narrow and rather deep. Epinotum with subequal base and declivity, the former straight and horizontal in profile, the latter sloping and concave; spines very large, decidedly longer than the base of the epinotum, curved a little downward towards their slender, pointed tips and directed upward, outward and backward. Petiole from above a little more than twice as long as broad, broader behind than in front, with feebly concave sides; in profile the node is low and angular, with long, concave anterior and short, concave posterior declivity. Postpetiole about twice as broad as the petiole, a little broader than long, with straight, parallel sides and rounded anterior border. Gaster regularly elliptical, smaller than the head.

Body shining throughout; mandibles glabrous; clypeus delicately rugulose on

the sides, smoother in the middle. Frontal area longitudinally rugulose. Head, with the exception of its smooth lower surface, cheeks and extreme posterior corners, traversed by sharp and rather numerous longitudinal rugæ, separated by fine, shallow, and therefore rather indistinct punctures. Thorax covered with very similar, sharp rugæ with intervening punctures, but the former run transversely on the dorsal surface and are continued down vertically on the pleural surface. Declivity of epinotum, petiole, postpetiole, gaster, legs and antennæ smooth and glabrous except for very fine, scattered piligerous punctures.

Hairs short, grayish, suberect and rather sparse, covering the legs and scapes as well as the whole body.

Black; mandibles, except their borders, lower surfaces and articulations of thorax, petiole, postpetiole, funiculi, and legs tinged with deep red. In some specimens the head too may be reddish.

Worker. Length 2.5–3 mm.

Head a little longer than broad and a little broader behind than in front, with convex sides, rather straight posterior border and broadly rounded posterior corners. Eyes convex, at the middle of the sides of the head. Mandibles with two larger apical and several minute basal teeth. Clypeus convex in the middle, with entire, broadly rounded anterior border. Antennal scapes reaching nearly $\frac{1}{3}$ their length beyond the posterior corners of the head. Shape of thorax, petiole, and postpetiole much as in the soldier, the postpetiole, however, being as long as broad and more campanulate. The epinotal spines are fully as long as in the soldier, though perhaps a little more slender and a little more curved.

Like the soldier also in scuplture, pilosity and color, except that the fine punctures between the sharp rugæ on the head and thorax are more numerous and deeper so that these parts seem to be more opaque.

Described from several soldiers and workers taken from a single "populous and aggressive colony, nesting in a rotting log, near Troy" (Wight).

This species, owing to the *4-jointed antennal club, must be placed in Pergande's subgenus *Ceratopheidole*, although it differs considerably in habitus from the two species hitherto assigned to this group. The type (*C. granulata*) was described from two Mexican specimens which Pergande doubtfully regarded as soldiers. They had 4-jointed antennal clubs, much smaller epinotal spines than *C. hecate*, measured 5.6 mm. and were reddish yellow. Forel in Biol. Centr. Amer. Hymen., III, 1899–1900, p. 77–78, was inclined to criticise Pergande for establishing a subgenus on two specimens, but he later accepted it for an Indian *Pheidole* (*Ph. smythiesii* Forel). This species, however, like certain American forms of *Pheidole sensu stricto* (*Ph. vasliti, arizonica, instabilis,* etc.) is not dimorphic but polymorphic in the worker caste, since it presents a series of intermediates between the soldier and worker proper.

29. ***Pheidole** (**Ceratopheidole**) **hecate malevola** subsp. nov.

Soldier. Differing from the soldier of the typical form in the sculpture of the head, the sharp longitudinal rugæ being abbreviated at their posterior ends and

laterally, so that the smooth lateral and posterior surfaces extend much further forward and medially. The rugæ reach the posterior border only in the middle line and are distinctly less numerous and the interrugal punctures are much less distinct than in the typical *hecate*. This is especially true of the rugæ lateral to the frontal carinæ, which are very short, feeble and sparse. Head, thorax, petiole, postpetiole and appendages deep blackish red; gaster black; mandibles ferruginous with broad black borders.

Worker. Differing from the worker of the typical form in having the whole upper surface of the head smooth and shining, except for a few feeble indications of the sharp longitudinal rugæ anteriorly between the frontal carinæ and on the cheeks. In workers from one colony the interrugal punctures on the thorax are very distinct, in another set they are almost imperceptible. Both lots are black like the workers of the typical form, with deep red mandibles, legs and funiculi.

Described from a series of soldiers and workers taken by Mr. Wight at Kingston and several workers taken by Dr. Grabham at Newcastle (3500 ft.). It is this latter set of workers that has the cephalic sculpture of *malevola* combined with the indistinct thoracic punctation of the typical *hecate*.

30. ***Cremastogaster brevispinosa** *Mayr.*— Many workers from Troy and Mandeville (Wight) and Kingston (Grabham) agree very well with specimens of the typical form from other parts of tropical America.

31. ***Cremastogaster brevispinosa** var. **minutior** *Forel.*— Workers from several colonies taken at Balaclava (Wight) and Kingston (Grabham and Andrews).

32. **Cremastogaster victima** *F. Smith* var. **steinheili** *Forel.* A few workers from Kingston (Grabham) and some males and females without precise locality (Wight).

33. **Tetramorium guineense** (*Fabr.*).— A few workers from Troy and Balaclava (Wight).

34. ***Tetramorium** (**Tetrogmus**) **simillimum** *Roger.*— Workers and numerous females, both winged and deälated, from Troy and Balaclava (Wight).

35. **Wasmannia auropunctata** (*Roger*).— Workers, males and females from several colonies; Balaclava (Wight).

36. ***Strumigenys alberti** *Forel* var. **nigrescens** var. nov.

A single worker from Mandeville (Wight) differs from the typical form of this species from St. Vincent in coloration. The clypeus, head, thorax, petiole and first gastric segment are black or very dark brown, the mandibles, postpetiole and tarsi ferruginous, the tibiæ and femora nearly as dark as the head.

37. **Rhopalothrix simoni** *Emery* var. **wighti** *Wheeler.*— Five workers from Troy (Wight).

38. **Atta (Trachymyrmex) jamaicensis** *Ern. André.*— Nine workers from Kingston (Grabham).

39. **Cyphomyrmex foxi** *Ern. André.*— Twenty workers from Kingston (Grabham) agreeing perfectly with André's description of this form which is known only from Jamaica.

40. **Cyphomyrmex rimosus minutus** *Mayr.*— Numerous workers and a few winged females from Balaclava, Troy and Mandeville (Wight).

Subfamily Dolichoderinæ.

41. ***Dorymyrmex pyramicus** *Roger* var. **niger** *Pergande.*— Workers from Balaclava (Wight) and Kingston (Grabham).

42. ***Iridomyrmex iniquus** *Mayr.*— Numerous workers from Troy and Mandeville (Wight) and Kingston. This species, as Forel has observed, nests in the ground.

43. **Tapinoma melanocephalum** (*Fabr.*).— Numerous workers from Kingston (Grabham).

Subfamily Camponotinæ.

44. ***Brachymyrmex heeri** *Forel.*— Workers from Kingston and Mandeville (Wight) belonging to the pale, typical form of the species.

45. **Brachymyrmex heeri** *Forel* var. **obscurior** *Forel.*— Workers from Troy, Balaclava and Mandeville (Wight) and Kingston (Grabham).

46. **Prenolepis (Nylanderia) fulva** *Mayr.*— Workers, males and deälated females from several colonies from Troy and Mandeville (Wight) and Kingston (Grabham).

47. **Prenolepis (Nylanderia) longicornis** (*Fabr.*).— Several workers from Kingston (Grabham).

48. **Camponotus capperi** *Forel.*— Many workers from several colonies taken at Troy, Mandeville and Balaclava (Wight).

49. **Camponotus capperi corticalis** *Forel* var. **subdepilis** *Wheeler.* — Several workers from Troy (Wight).

50. ***Camponotus maculatus picipes** (*Oliv.*) — A few workers from Mandeville (Wight) come very close to the var. *pilosulus* Forel of this subspecies, but they have the thorax a little more coarsely punctate and opaque.

51. **Camponotus hannani** *Forel.*— Numerous major and minor workers and a deälated female from Balaclava, Mandeville and Troy (Wight).

52. **Camponotus hannani willardi** *Forel.*— Both major and minor workers from Kingston (Grabham).

59.9,53P(52)

Article IV.—A NEW PORPOISE FROM JAPAN.

By Roy C. Andrews.

On June 18, 1910, while the guest of the Oriental Whaling Company, Ltd. (Toyo Hogei Kabushiki Kaisha), at their station at Aikawahama in the north of Japan, a porpoise was secured which is apparently new to science. This specimen, an adult male, was captured by Capt. Y. E. Andersen of the whale ship "Hogei Maru No. 5," who recognized that it was a species unknown to him and went to considerable trouble to secure and preserve it for me. So far as could be discovered by inquiries among the whalers and fishermen no other porpoise like it had been seen or taken, and it is probable that the animal is rare.

As I was absent from the station at the time, I did not see this specimen until four days after it had been killed. The body had been opened ventrally and the viscera removed, otherwise it was intact. This porpoise in coloration, shape of the dorsal fin, number of vertebræ and skull characters is allied to *Phocæna dalli* True. Thus, so far as is known, the existing *Phocæna*-like porpoises fall into two natural groups which I believe to merit full generic rank.

On the one hand, we have *Phocæna* Cuvier, comprising species in which the coloration is entirely black, or black above shading gradually into lighter below, the dorsal fin triangular, the crowns of the teeth spade-shaped and separated from the root by a distinct neck, and the vertebræ 64 or 65. The species are *P. phocæna* (Linn.) and *P. spinipinnis* Burmeister.

On the other hand, a group in which the coloration is black above with large, sharply defined side and ventral areas of white, extremely small teeth the crowns of which are somewhat compressed and separated from the root by a slight constriction, and vertebræ numbering 95 or more. This group, to which I believe *Phocæna dalli* True should be referred, and a species here described as new, may be diagnosed as follows,—

Phocœnoides gen. nov.

Type, *Phocœnoides truei* sp. nov.

Rostrum of skull wide and flat; intermaxillæ elevated proximally to form two prominent bosses in front of nares. Nares large. Pterygoids small and widely separated. Temporal fossæ small. Teeth very small, the crowns compressed and separated from the root by a slight constriction. Vertebræ 95 or more. Neural spines of vertebræ very long and slender. Head without beak. Dorsal fin falcate and situated near the middle of the back.

In view of the important cetological researches of Dr. F. W. True, and the fact that he was the first to make known the other member of the genus, it is eminently fitting that this new porpoise should be described as,

Phocœnoides truei sp. nov.

Type, No. 31425; ad. ♂, Aikawahama, Rikuzen Province, Japan, June 18, 1910.

Color.— Entire head, throat and back black; sides, posterior breast (except median line) and belly white. On the sides the white areas are sharply defined and reach forward slightly beyond the anterior insertion of the pectoral fins; posteriorly they end on the sides of the peduncle in falcate patches the convexities upward (Plate II, Fig. 1). The black of the throat extends backward in a narrow band on

Fig. 1. *Phocœnoides truei.* Pectoral fin.

the mid-ventral line of the breast ending 210 millimeters behind the posterior insertion of the pectoral fins.

On the inferior surface of the caudal peduncle, the black extends forward in a trident-shaped patch to a point shortly beyond the anus (Plate II, Fig. 2). Just

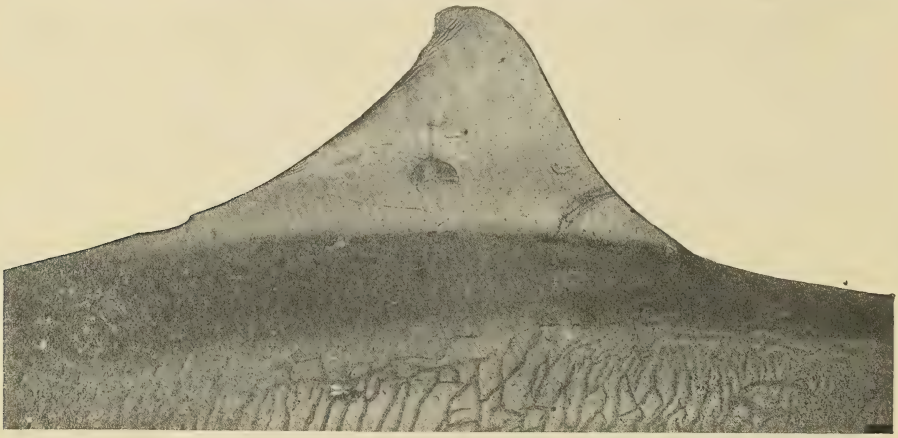


Fig. 2. *Phocœnoides truei.* Dorsal fin.

anterior to the insertion of the flukes the ventral surface and lower sides of the caudal peduncle are occupied by a well-defined grayish area thickly marked with short, longitudinal black lines; ventrally this area is 200 mm. long.

Pectoral fins.— Both fins are black above and below except for a small patch of grayish, faintly marked, at the angle. The fins are falcate, and the angles rounded (see Fig. 1).

Dorsal fin.— The upper half (except the posterior edge) is whitish marked with a few short, scattered, black lines. The remainder is black. The fin is situated on a long base; the posterior edge is concave and the tip slightly recurved. Fourteen

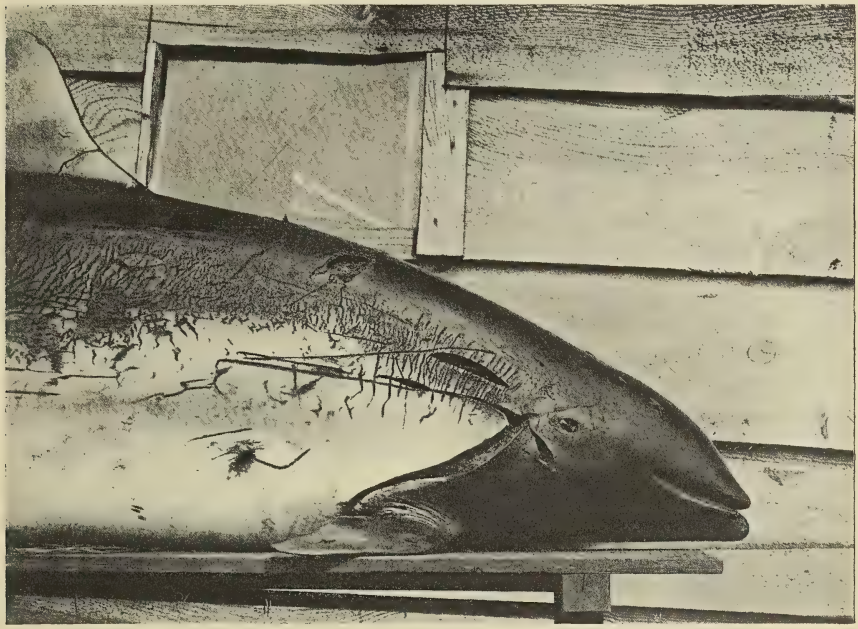


Fig. 3. *Phocœnoides truei.* Head and anterior portion of body.

small, spinous tubercles similar to those found in *Phocœna* are present upon the anterior edge near the distal extremity. The anterior base of the dorsal fin is 25 millimeters behind the junction of the first and second thirds of the total length of the body measured along the side (Fig. 2).

Flukes.— Similar above and below. Black, except for a whitish band on each lobe running from the notch along the posterior border for a short distance and obliquely across, meeting the anterior edge 50 millimeters from the tip (Plate II, Fig. 2).

Head.— The head is short and narrows rapidly from the eyes to the snout. The lower jaw projects slightly beyond the upper.

Caudal peduncle.— The caudal portion of this specimen presents a most extraordinary shape which is approximated by no other known member of the Delphinidæ. From the dorsal fin to a point 300 millimeters anterior to the insertion of the

flukes the upper edge is nearly parallel with the body axis; at that point it slants abruptly down to the flukes. On the ventral surface, at a point midway between the anus and the insertion of the flukes, is a prominent concavity (Plates I and II, Fig. 1).

This form of the peduncle is so remarkable that the question has been raised as to whether it might not be a malformation due to injury or similar causes. This hypothesis, however, cannot have great weight since there is no indication of a pathological condition of the vertebræ or any other part of the skeleton. The extreme height of the neural spines of the caudal vertebræ and their peculiar shape will be discussed later. A very careful examination of the entire body before it was dissected revealed no suggestion of injury, and I cannot but conclude that the shape of the peduncle is not abnormal for the species.

It is interesting in this connection to note that both edges of the caudal region of *P. dalli* are raised into prominent flange-like extensions, being quite a departure from the usual shape of the peduncle among other members of the Delphinidæ. Thus are suggested most interesting possibilities as to what may be learned of the limits of variation when other specimens of the genus become known.

The most important external differences between *P. dalli* and *P. truei* are as follows:

1. The white areas on the sides of *P. dalli* extend forward only as far as a point opposite the anterior base of the dorsal fin; in *P. truei* the white areas are continued slightly beyond the anterior insertions of the *pectoral* fins.

2. On the lower surface of the peduncle, just anterior to the flukes, *P. truei* has a patch of gray marked with short, black lines. *P. dalli* presents no such coloration.

3. In *P. truei* the trident-shaped ventral extension of black, in the center of which the anus is situated, is of a quite different pattern from the disposition of the colors in the corresponding region of *P. dalli.*

4. The shape of the body of *P. truei* posterior to the dorsal fin is totally unlike that of *P. dalli.*

5. In *P. dalli* the flukes are apparently black on both surfaces while those of *P. truei* show distinct whitish markings.

External measurements.— Two series of measurements were taken; one for direct comparison with *P. dalli*; the other containing additional measurements of value in further designation of the species.

External Measurements.

	P. truei mm.	*P. dalli* mm.
Total length (straight from snout to notch of flukes)	1915	1829
Tip of lower jaw to corner of mouth	134	89 [1]
" " " " " center of eye	233	177
" " " " " anterior base of pectoral	305	279
" " " " " anterior edge of blowhole	260	228
" " " " " anterior boundary of white area	310	692
" " " " " genital slit	765	1093
Eye to blowhole (vertical)	168	102
Blowhole to anterior base of dorsal fin	505	470
Length of eye opening	22	19
Anterior base of pectoral to tip	233	203
Posterior " " " " "	163	146
Breadth of pectoral at base	103	95 [2]
Height of dorsal (vertical)	165	152
Length of base of dorsal	360	267
Notch of flukes to anus	620	578
Flukes, tip to tip	469	470
Breadth of flukes (antero-posterior)	180	133
Height of body at insertion of flukes	106	89
Length of white area along belly	735	457
Depth of body 24″ anterior to flukes	535	254
" " " 8″ " " "	270	190

	P. truei mm.
Total length over curve of back from snout to notch	2115
Snout to eye	233
" " " corner of mouth	125
" " blowhole (center)	250
" " posterior insertion of pectoral fin (axilla)	415
" " posterior insertion of dorsal fin	1110
Notch of flukes to penis	765
Pectoral fin, tip to head of humerus	220
" " " " posterior insertion	163
" " " " anterior insertion	233
" greatest breadth (at angle)	105
Depth of notches of flukes	30
Length of right lobe of flukes axially	251
" " left " " " "	245

[1] It will be seen that there is a great difference between the two specimens in this measurement. Since the skulls do not bear this out, however, I believe that it is possible that one may have been from the interior and the other from the exterior corner of the mouth and that the apparent discrepancy could thus be accounted for.

[2] Through a misinterpretation of Dr. Dall's mss. notes, Dr. True gave the breadth of the fin of *P. dalli* across the base as 5.5 inches. After a further examination of the notes he writes me that the "5.5 inches" is probably the *distance between the pectorals across the breast* and that the actual basal breadth of the fin is 3.75 inches (95 mil.).

	P. truei mm.
Depth of body midway between insertion of flukes and anus, which is the point where the upper margin begins to descend to flukes	304
Distance apart of anterior bases of pectoral fins (below)	157
" " " posterior bases of pectoral fins (below)	203
Lower jaw extends beyond upper	7
Distance from corner to corner of mouth over head	275
Girth of head at eyes	685
" " body directly in front of pectoral fins	835
" " body at posterior insertion of dorsal fin	1285
" " body at anus	817
Length of anal opening	13
Corner of mouth to anterior insertion of pectoral fin	210
Distance of eye above line of mouth	20
Length of white area on sides	1175
Width of blowhole across tips	49

Osteology.

Skull.— There is a very close resemblance between the skull of this specimen and that of the type of *P. dalli*, the two being directly comparable as to age. In the latter species the maxillæ are bent more sharply upward on either side of the superior nares than in the former. The rostrum is proportionately a little shorter and broader, and at the middle of the beak the intermaxillæ are slightly wider than in *P. dalli*; the mandible of our specimen is also somewhat longer and heavier proportionately. All of these differences, however, could easily fall within the range of individual variation and I do not consider them to be of specific importance.

This close resemblance between the skulls of the two species is most interesting when one considers the strong external differences. Measurements of the skull of *P. truei* and of the type of *P. dalli* are appended in the table following:

Measurements of skull of P. truei and of the type of P. dalli.

	P. truei	*P. dalli*
Total length	339	333
Length of beak	140	140
Breadth of beak at base of notches	98	95
" " " " its middle	62	57
" " intermaxillæ at same point	41	35
Greatest breadth between outer margins of intermaxillæ proximally	54	51
Length of alveolar margin	97	—
Tip of beak to anterior margin of superior nares	185	178
" " " " end of crest of pterygoid	212	213
Breadth between orbital processes of frontal	169	165
" " hinder margins of temporal fossæ	171	162

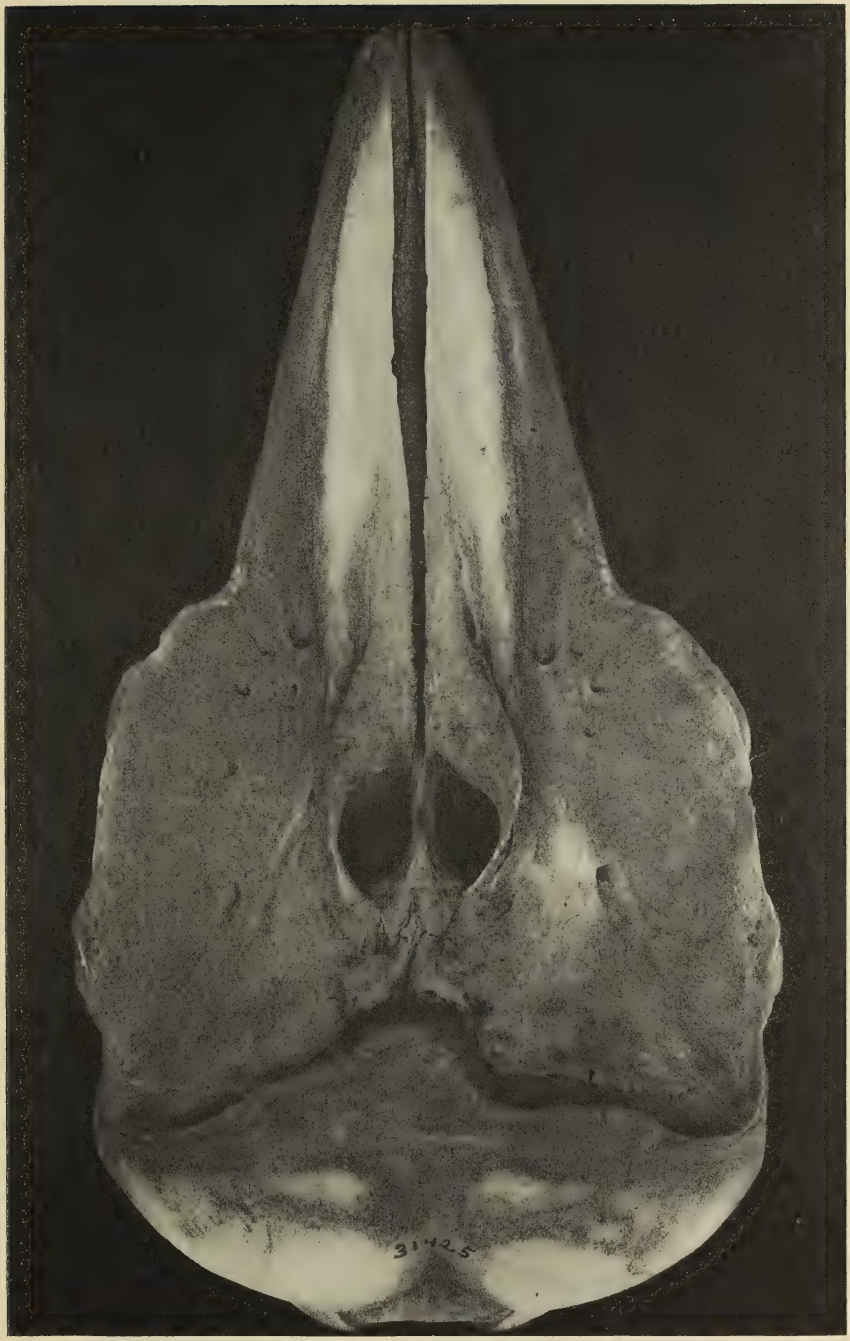


Fig. 4. *Phocænoides truei.* Dorsal view of skull.

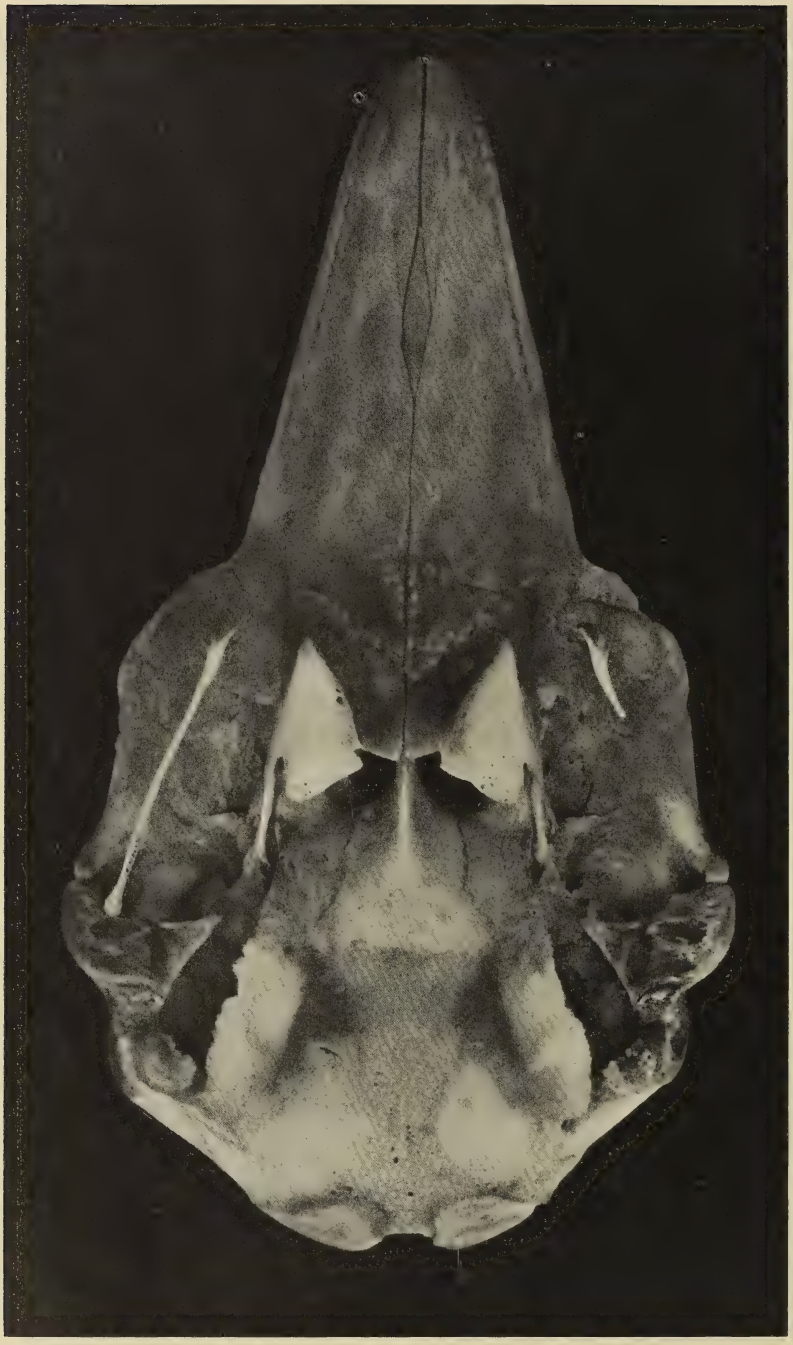


Fig. 5. *Phocænoides truei.* Ventral view of skull.

Fig. 6. *Phocænoides truei.* Lateral view of skull.

Fig. 7. *Phocænoides truei.* Lateral view of mandible.

	P. truei	*P. dalli*
Greatest breadth of skull (squamosal)	190	—
Length of temporal fossæ	44	56
Depth " " "	32	26
Total length of mandible	265	255
Length of symphysis of mandible	35	38
" " alveolar margin of mandible	120	—
Depth between angle and coronoid	65	57

Teeth.— The teeth of this specimen are exceedingly small and in life project but slightly above the surrounding membrane. Those of the lower jaw are cylindrical and show a slight swelling at the head; they have apparently been considerably worn. The teeth of the upper jaw, under a

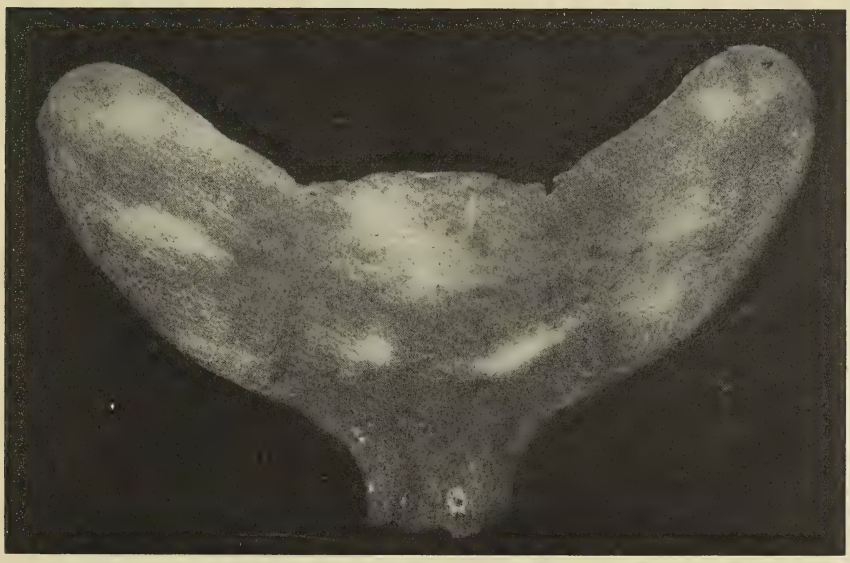


Fig. 8. *Phocænoides truei.* Basihyal and thyrohyals.

low-power magnification, show a compressed, somewhat spade-shaped crown and a slightly constricted neck. The teeth are smaller than those of *P. dalli* and have the crowns and neck less well developed.

The dental formula is $\frac{19\text{-}19}{22\text{-}22}$. The teeth were counted while the animal was in the flesh and the formula as given represents the number that were found upon inspection with the aid of a low-power glass. I was led to believe, however, upon macerating the specimen, that in both jaws several teeth were present which did not show above the surface and were lost.

Vertebræ.— The specimen was dissected with extreme care and the dif-

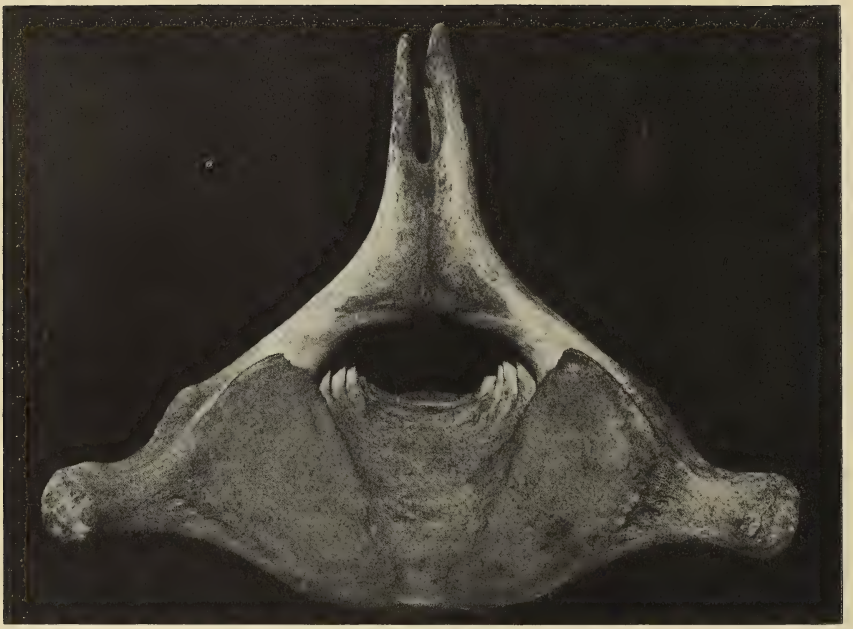


Fig. 9. *Phocænoides truei.* Atlas and cervical vertebræ.

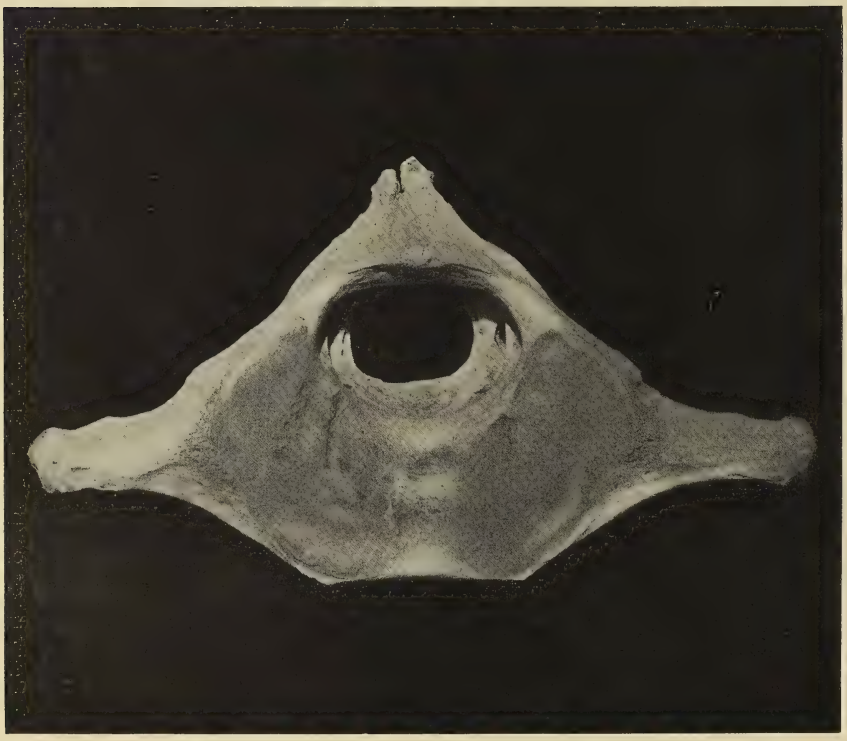


Fig. 10. *Phocæna phocæna.* Atlas and cervical vertebræ.

ferent segments of the vertebral column accurately determined. The formula is as follows — C. 7, D. 16 (or 17), L. 26, Ca, 46 = 95.[1] The seven cervical vertebræ are solidly ankylosed both by their centra and neural spines. The atlas bears short, thick transverse processes which arise below the middle of the centrum and are directed slightly downward and forward. Its neural spine is erect, very high and deeply bifurcated. The atlas is unlike either that of *Phocæna* or *Lagenorhynchus.*

Of the dorsal vertebræ the transverse processes are shorter and less massive, the neural spines are much higher and the centra of the vertebræ are more compressed antero-posteriorly than in either *Lagenorhynchus* or *Phocæna*; the centrum of the last dorsal is but little more than half as thick as that of the corresponding vertebra in the other two genera. The transition from the rib-bearing to the lumbar series is abrupt.

Fig. 11. *Phocænoides truei.* First dorsal vertebra. Nat. size.

Fig. 12. *Phocæna phocæna.* First dorsal vertebra. Nat. size.

[1] The vertebral formula of *P. truei* is C. 7, D. 14 (or 15), L. 27, Ca. 49 = 97 (or 98).

Fig. 13. *Phocænoides truei.* First lumbar vertebra. Lateral view.

The extremely long, slender, rod-like neural spines and transverse processes, and the greatly compressed centra which make the vertebræ of this specimen remarkable are present throughout the lumbar and caudal series. The lumbar vertebræ resemble those of *Lagenorhynchus,* except that the spines in that genus are much lower and both the spines and transverse processes are more compressed laterally and consequently less rod-like.

The second lumbar is the last vertebra to bear

Fig. 14. *Phocæna phocæna.* First lumbar vertebra. Lateral view.

Fig. 15. *Phocænoides truei.* First lumbar vertebra. Dorsal view. ½ nat. size.

Fig. 16. *Phocæna phocæna.* First lumbar vertebra. Dorsal view. ½ nat. size.

Fig. 18.

Fig. 17. *Phocænoides truei.* First caudal vertebra. Lateral view.
Fig. 18. *Phocæna phocæna.* First caudal vertebra. Lateral view.

a distinct zygapophysis, while in *Phocæna phocæna* these persist far back into the caudal series; in *Lagenorhynchus obliquidens* the zygapophyses are lost on the fifth lumbar but appear again high up on the spines of the second or third caudal.

The disappearance of the transverse processes is very gradual, and on the twenty-second caudal, where the process shows as merely a tubercle, the spine is still 57 mm. long and the centrum, including the epiphyses, only 18 mm. thick.

The terminal caudal is very small and seems to be composed of two ankylosed portions; all the remaining vertebræ, except the cervicals, are free.

Fig. 19. *Phocænoides truei.* First caudal vertebra. Dorsal view.

Fig. 20. *Phocæna phocæna.* First caudal vertebra. Dorsal view.

Measurements of Vertebræ.

	Atlas.	1st dorsal.	1st lumbar.	1st caudal.
Greatest depth from tip of spine to ventral edge of centrum	117	122	182	175
Greatest breadth between distal ends of transverse processes	139	79	209	178
Distance from tip of spine to superior edge of centrum	—	94	151	145
Length of transverse processes	27	23	88	69

Chevrons.— There are thirty-five in the entire series. The two or three pairs of small chevrons so commonly present in porpoises at the beginning of the series are absent in this specimen and the first is long but free distally. The laminæ of the second are very broad and the spine is pointed; it is slightly longer than the first. The third is of about the same width as the first but is longer than the second. The fourth and fifth chevrons are very narrow and are somewhat longer than the third. The sixth is slightly wider and longer than the fifth, the seventh longer and broader than the sixth, and the eighth is the longest of the series. From this point backward they decrease very gradually in length and increase in breadth. The second and fifteenth chevrons are about equal in height as they stand in position. The last is exceedingly minute but shows definite ossification. These observations were taken while the chevrons were *in situ.*

Fig. 21. *Phocænoides truei.* External surface of sternum.

Ribs.— There are sixteen pairs of ribs articulating with the vertebral column; an additional pair, very short and unattached to vertebræ or sternum, were present and would have been overlooked except by careful dissection. In giving the vertebral formula I have considered the dorsal series as sixteen.

Sternum.— The sternum is smaller, more slender, and its expanded anterior end is of different shape than in *Phocæna.*

Scapula.— The scapula of this specimen is decidedly interesting. It is totally unlike that of *Phocæna phocæna* and *Lagenorhynchus obliquidens* with which I compared it, but somewhat resembles the figured scapula of *Lagenorhynchus leucopleurus* Rasch (= *L. acutus* Gray) in the 'Ostéographie' of Van Beneden and Gervais.[1]

The most striking feature of the scapula is its extreme height in proportion to its width, the vertical length being but little more than the

Fig. 22. *Phocænoides truei.* Right scapula.

greatest breadth. The superscapular edge is nearly straight and dips abruptly downward anteriorly to meet the corocoid border. The prescapular fossa is narrow and not strongly marked. Measurements of the scapula of this specimen and of an adult *Phocæna phocæna* and *Lagenorhynchus obliquidens* are appended.

	P. truei. mm.	*P. phocæna.* mm.	*L. obliguidens.* mm.
Length	150	101	116
Greatest breadth	166	149	181
Length of the acromion	33	37	43
" " " corocoid	29	28	38

[1] Ostéographie des Cétacés, plate xxxv, fig. 23.

Manus.— The humerus is shorter proportionately, more massive, and the condyle decidedly more lateral in position than in *Phocæna.* The radius is flat, has the anterior margin convex and the distal end widened and rounded. The ulna is short and remarkable for the deeply concave outer edge; the olecranon process is well developed. In shape and arrangement the carpal bones are essentially as in *Phocæna.* The formula for the phalanges is — I_1, II_6, III_5, IV_1.[1]

Conclusions.— In addition to the peculiar external appearance, the skeleton shows that in several respects *Phocænoides truei* stands unique among the entire family, for the extremely long, slender spines and transverse processes of the vertebræ and the high, narrow scapulæ are unlike all the other known members of the Delphinidæ. Although many external characters and the skull and teeth show a decided relationship to *Phocæna,* the remainder of the skeleton is totally unlike that genus. In the high vertebral formula, the shape of the scapula, and of the lumbar and caudal vertebræ, there are apparently affinities to *Lagenorhynchus.* It will be extremely interesting to see how far *P. dalli* participates in these aberrant characters, when the skeleton of that species becomes known.[2]

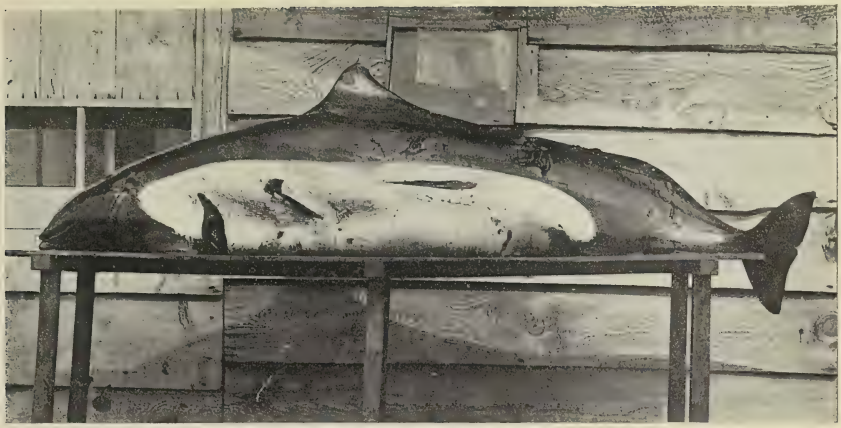
I wish to express my indebtedness to the Oriental Whaling Company, Ltd., for the many privileges which were generously extended to me during my stay at their stations, and to Captain Y. E. Anderson who captured the porpoise here described. Acknowledgments are due Dr. F. W. True for the privilege of examining the type of *P. dalli* and the loan of other specimens. Dr. True also rendered valuable assistance in my study of the material here described.

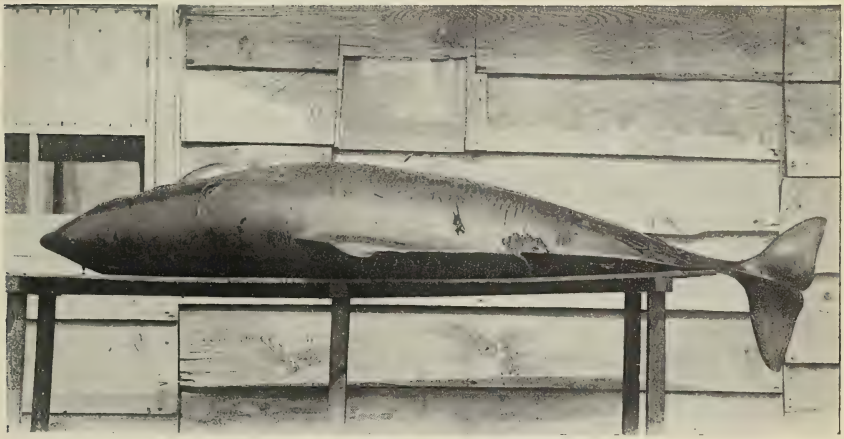
---

[1] The formula for the phalanges of *P. dalli* is I_1, II_6, III_4, IV_2.

[2] Dr. W. H. Dall, after inspecting the caudal vertebræ of this specimen, informed me that to the best of his remembrance *P. dalli* did not possess neural spines of such a height.

Fig. 23. *Phocænoides truei.* Pectoral fin





Phocænoides truei sp. nov.

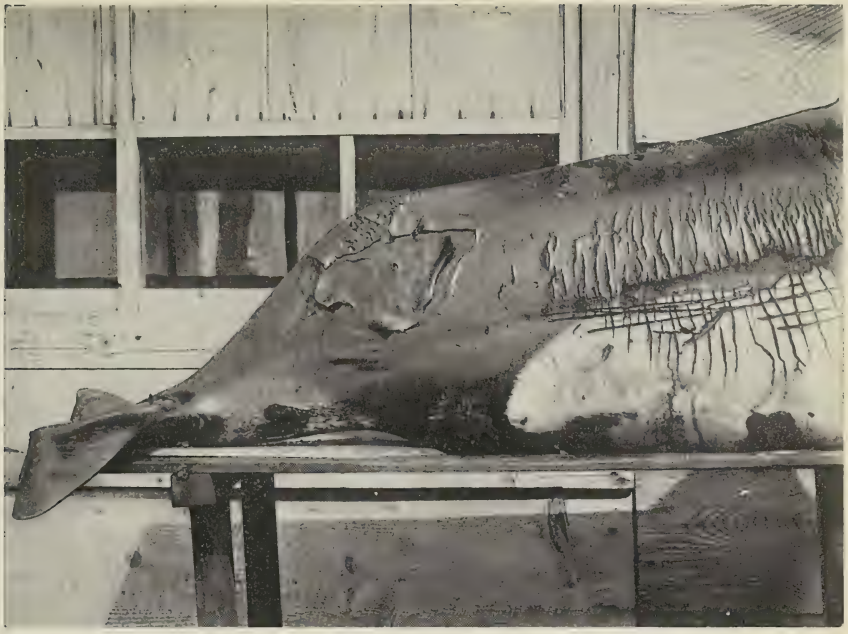


Fig. 1. *Phocænoides truei* sp. nov. Lateral view of peduncle.

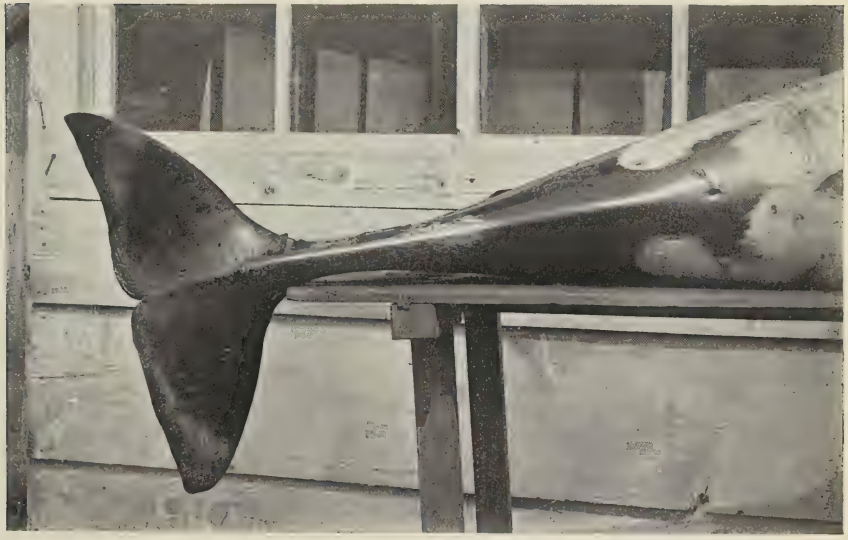


Fig. 2. *Phocænoides truei* sp. nov. Ventral view of peduncle.

56.57,6(78.8)

Article V.—FOSSIL COLEOPTERA FROM FLORISSANT, WITH DESCRIPTIONS OF SEVERAL NEW SPECIES.

By H. F. Wickham.

This paper is concerned with a collection of fossil beetles secured at Florissant by various expeditions under the charge of Professor Theo. D. A. Cockerell of the University of Colorado. Through his kindness, the series has been transmitted to me for study, and I have thought it worth while to make an occasional note on described species, as indicating, in a way, their relative abundance at the time of the formation of the shales wherein they are entombed. Judging from the number of striking new species, the possibilities of these shales, in the way of still further illustrating the life of the olden time, has by no means been exhausted.

Arranged by families, the species treated of are as follows:

Carabidæ.

Harpalus maceratus n. sp.

Dytiscidæ.

Miodytiscus hirtipes n. gen. et sp.

Hydrophilidæ.

Hydrobius prisconatator n. sp.

Staphylinidæ.

Tachinus sommatus *Scudd.*

Parnidæ.

Dryops eruptus n. sp.

Dascyllidæ.

Dascyllus lithographus n. sp.

Lymexylidæ.

Lymexylon lacustrinum n. sp.

Lucanidæ.

Ceruchus fuchsii n. sp.

Scarabæidæ.

Aphodius florissantensis n. sp.
" laminicola *Wickh.*
Ligyrus compositus n. sp.

Cerambycidæ.

Elaphidion fracticorne n. sp.
Callimoxys primordialis n. sp.

Chrysomelidæ.

Colaspis ætatis n. sp.
Diabrotica exesa n. sp.

Melandryidæ.

Synchroa quiescens n. sp.

Rhynchitidæ.

Docirhynchus culex *Scudd.*
Toxorhynchus grandis n. sp.

Otiorhynchidæ.

Otiorhynchites florissantensis n. sp.
Cyphus subterraneus n. sp.

Curculionidæ.

Geralophus antiquarius *Scudd.*
" occultus *Scudd.*
" scudderi n. sp.
" repositus *Scudd.*
" lassatus *Scudd.*
" fossicius *Scudd.*
Apion cockerelli n. sp.
Cleonus rohweri n. sp.
Magdalis striaticeps n. sp.
Ceutorhynchus clausus *Scudd.*
Balaninus restrictus *Scudd.*
" minusculoides n. sp.
" minusculus *Scudd*

Calandridæ.

Scyphophorus tertiarius n. sp.

Anthribidæ.

Cratoparis adumbratus n. sp.

Scolytidæ.

Hylesinus extractus *Scudd*

Harpalus *Latr.*

H. maceratus n. sp. The specimen, with its reverse, represents a species equalling in size the large individuals of our common recent *H. pennsylvanicus* and *H. erraticus*, but while the outlines have been well preserved the body has been so badly macerated that all details of sculpture and all sutures are lost. The head is broad, nearly as wide as the prothorax (as preserved), this latter, however, is apparently defective on one side while the other is irregular but approximately straight and without evidences of tapering towards either end — I think undoubtedly distorted. Body broadest across the area between the middle and hind legs, arcuately narrowing posteriorly. Antenna, as far as shown, indicating joints proportionately similar to those of *H. erraticus*. Front tarsus moderately dilated, showing that the specimen was a male. Hind legs more slender than in *H. erraticus*, middle leg mostly wanting, but the tarsus is seen to be somewhat dilated. Length, 19.50 mm.; of hind tibia, 5.35 mm.; of front tarsus without claws, 3.00 mm.; of four antennal joints (probably the 3rd, 4th, 5th and 6th), 4.15 mm. Width across base of mandibles, 3.75 mm.; of body at widest point, 7.00 mm.

Station number 14. Collected at Florissant by Mrs. Cockerell. The type is in the Museum of the University of Colorado.

The elytra are not distinguishable in the specimen. The mandibles are of the projecting type shown in *H. erraticus*, giving the appearance of a sort of muzzle. It is a much larger insect than any of the fossil Florissant species described by Dr. Scudder.

Miodytiscus n. g.

Related to the modern genus *Dytiscus*, resembling in form the common *D. fasciventris* but somewhat narrower, the distance from the middle coxæ to the insertion of the hind legs very much less. Hind femora broad, sub-elliptic in outline with a distinct row of numerous rather long strong bristles near the posterior margin which is thus bordered by them for nearly its entire length. Hind tibiæ fringed internally with long hairs.

I have ventured to establish this genus principally on account of the vestiture of the hind legs, this being different from that of any other known Dytiscid, if one may judge by the full discussion of characters in Dr. Sharp's monograph of the family. Unfortunately I cannot satisfy myself as to the structure of the coxal plates and the metasternum. The punctuation of the elytra, as far as shown, is a very unusual type, if, indeed, it occurs elsewhere in the Dytiscidæ.

M. hirtipes n. sp. Form ovate, slightly wider behind the middle, as in most recent species of *Dytiscus*. Head a confused mass with no details of sculpture or appendages visible. Prothorax, as preserved, with the sides not continuing the outline of the elytra, less convergent towards apex than usual in this family. Elytra

showing through the abdominal elements, with apparently nine or ten striæ not strongly impressed, those on the disk showing only traces of scarcely discernible punctures, the four or five nearest the outer margin finely and distinctly but distantly punctate; a few scattered punctures are also seen in the basal marginal region. Middle coxæ approximate, the femora of this pair of legs thick, rather regularly narrowly elliptical, with a longitudinal row of closely set fine bristles extending about the full length and inserted a short distance inside of the posterior margin, tibiæ not differing much in length from the femora, stout, apparently with scattered short appressed spines (possibly like those occupying the same area in modern species of *Cybister*), the only exposed terminal spur long, tarsi not much flattened, claws not shown. Hind legs approximate at the trochanterial insertion, though this region is slightly obscured, femora broader than the middle pair and similarly armed with bristles, tibiæ about like the intermediate ones, tarsi not very broad but not clear. Abdomen showing six ventral segments, about smooth except for a fine median carina. Length, 24 mm.; from posterior edge of middle coxæ to base of hind femur, 3.85 mm.; of middle femur, 4.65 mm.; of hind femur, 4.75 mm.; of their tibiæ, about the same. Width, at widest part, of elytra, 15.50 mm.; of middle femur, 1.75 mm.; of hind femur, 2.85 mm.

Station R. 14. No collection number. Florissant Expedition, 1907. The type is in the American Museum of Natural History.

This is an exceptionally interesting specimen since it represents a beetle of a type hitherto unknown. My interpretation of it is that it indicates a Dytiscid of less specialized structure than any of the existent forms of like size. The most striking characters that can be made out with any certainty are the spiny armature of the femora and the shortness of the distance from the middle to the hind legs. Besides the vestiture mentioned in the preceding lines, certain impressions of bristles on the underside of the prothoracic region appear to represent a row on each front femur, of the same character as those on the femora of the middle and hind legs. Recent species of *Acilius* have a beautifully developed fringe on the front and middle femora, and certain forms of *Dytiscus* show the same structure in lesser degree.

Hydrobius *Leach.*

H. prisconatator n. sp. Not greatly differing from the modern *H. fuscipes*, if allowance be made for flattening. The exact proportions of length to width are made in the measurements at the end of this description. Head rounded anteriorly, the maxillary palpus about as in *H. fuscipes*, antenna also of the same general structure as in that species although the stem joints are thicker in the fossil and the club joints less abruptly larger and proportionately somewhat narrower. Prothorax broadest at about the base, sides regularly arcuately narrowing to apex, posterior angles obtuse, anterior somewhat projecting to the front but not sharp. Elytra subparallel at sides, arcuately narrowing posteriorly to apex, with about nine or ten fine, regular, subequidistant, apparently impunctured striæ. Scutellum triangular, about as in *H. fuscipes*. Legs short, all the tibiæ with distinct longitudinal grooves

marked with rows of spines similar to the structures on the same parts in that species. Tibial spurs strong, but none of them preserved in entirety. Tarsal claws apparently simple, they appear also to be less divergent than in *H. fuscipes*, but I believe this to be due to the position of the legs when the insect was enclosed in its matrix. Ventral abdominal segments five. The abdomen is slightly distended, giving the insect a somewhat greater length than normal. Length, total, 9.50 mm.; of head, 1.25 mm.; of prothorax along median line, 1.65 mm.; from middle to hind coxæ, along median ventral line, 1.00 mm.; of antenna, 1.40 mm. Width of prothorax at base, 3.50 mm.; of elytra at middle, a little more.

Two specimens, the type from Station number 14, numbered, with its reverse, 175 and 185, Florissant Expedition, 1906. The other, with reverse, is from the 1908 expedition and bears neither station nor collection number. While the antennal characters are drawn from one example, those of the palpus come from the other. The type is in the Museum of the University of Colorado. The cotype is in the American Museum of Natural History.

Aside from the striation of the elytra, very little of the sculpture can be made out. However, groups of coarse punctures (representing similar ones in *H. fuscipes*) are discernible near the front and hind thoracic angles. It is probable that the surface of the body was nearly smooth or very finely punctate. The generic reference seems quite safe.

Tachinus *Grav.*

T. sommatus *Scudd.* One specimen, in poor condition, comes from Station number J 4. It bears the collection number 22. No details additional to those given by Dr. Scudder can be made out.

Dryops *Oliv.*

D. eruptus n. sp. Preserved in dorsal view. A species is indicated resembling the recent *D. lithophilus* in outline but with the anterior margin of the prothorax much less emarginate, the front angles about right. Elytra with striæ faintly indicated, other surface sculpture obliterated. Legs long and slender. Length, 4.75 mm.; of elytra, 3.40 mm.; of prothorax along median line, 1.25 mm. Width of prothorax, 1.75 mm.; of elytra (conjointly) near middle, 2.35 mm.

Station number 13. Collection number 244. Florissant Expedition, 1906. The type is in the American Museum of Natural History.

While this specimen does not show any characters of import, the outline and the long slender legs are very characteristic of the genus to which I have referred it.

Dascyllus *Latr.*

D. lithographus n. sp. Preserved in dorsal view, with many of the structures of the underside showing through. Head and eyes, so far as determinable, of about the same form as in the recent *D. plumbeus*, maxillary palpi somewhat larger and stouter but with the joints similarly proportioned amongst themselves when compared to the corresponding structures in the before-mentioned species. Antennæ flattened, subserrate, the distal joints longer than the intermediate ones, and reaching to the middle coxæ or a little beyond. Prothorax broadest close to the base, tapering anteriorly, hind angle (showing on one side only) rather acute. Elytra with numerous fine longitudinal striæ of which at least twelve can be counted, while others, more or less confused, occupy the marginal area. These striæ are deeply but finely punctured, the punctures separated by at least their own diameters or by more than that distance towards the tip. Interstitial spaces smooth or nearly so, apparently slightly convex. Abdominal segments five in number, subequal, though the fifth is a little longer than the one preceding, its sides regularly arcuate to apex instead of being sinuate as in the two recent Californian species before me. Legs of moderate length and rather stout, the tarsi broad but with the individual joints not well shown. Length, 21.75 mm.; of head, 3.15 mm.; of prothorax, about the same, but the posterior margin is not well defined; of elytron, 14.65 mm.; of hind femur, 4.50 mm.; of hind tibia, 4.15 mm.; of middle tibia, a little less. I have omitted measurements of the width of prothorax and elytra, because of the uncertainty of the definitions of their margins.

Station number 17. Collected by Mrs. Cockerell. While this was taken at Florissant, the particular expedition is not specified. The type is in the Museum of the University of Colorado.

The only character which might lead one to doubt the accuracy of the generic assignment is the difference in the shape of the last abdominal segment, when the fossil is compared to the recent species. In other respects, the agreement seems very close. The genus has not been reported from the Tertiary deposits heretofore.

Lymexylon *Fabr.*

L. lacustrinum n. sp. Preserved in profile. Body elongate, head deflexed, finely rugosely granulate, eyes large, coarsely faceted, transverse but distorted in shape. Antenna short, weakly serrate from about the second joint, the second to eighth subequal in length and not greatly varying in width, each joint being approximately as broad as long. Palpus terminated by a large subcampanulate appendage. Prothorax elongate, disk finely granulate, side more finely so. Elytra shorter than the abdomen, narrow, subparallel at sides, separately rounding at tip, finely, closely evenly punctate. Abdomen apparently with five ventral segments, alutaceous. Length, 15 mm.; elytron, 9.75 mm.; of prothorax, 3.00 mm.; of terminal palpal appendage, 1.15 mm. Width of elytron about middle, 2.25 mm.; of palpal appendage near tip, 0.90 mm.

Station number 14. Collected by Mrs. Cockerell. The type is in the Museum of the University of Colorado.

This is a most interesting find, and introduces another new family into the Florissant fossil fauna. The identification seems satisfactory, the Lymexylidæ being quite peculiar in ocular, antennal and palpal structure, and the characteristic form of the body is well enough preserved. The abdomen is somewhat elongate, probably on account of maceration. The elytra retain enough of the original substance to show that the surface sculpture was of the fine nature shown in the European members of the family. The palpal appendage may be distorted a little, but its enormous size is the most striking feature of the fossil. The legs are about gone, a single portion of one tarsus showing it to have been slender. The insect was not far from the size of the recent North American *Lymexylon sericeum.*

Ceruchus *MacL.*

C. fuchsii n. sp. Preserved in dorsal view, showing head, thorax, one elytron, part of the antennæ and the abdominal segments, but without legs. The specimen, judging from the head, was a female, and is compared with recent species of the same sex. Head a little broader in proportion than in *C. striatus,* more narrowed anteriorly, the jaws about equally as prominent as in that species, antenna, when directed straight backwards, slightly encroaching on the prothorax. The left one seems to have the club damaged or showing on edge, the other exhibits the three enlarged terminal joints very plainly and indicates that they are not very different from the species with which it is compared. The intermediate joints are confused. Prothorax short, the coxæ, which show through, very transverse, extending about to the outer margin as in *C. striatus.* Elytron with about eight fairly well-marked costæ, between which are double rows of rather deep large punctures. Length, 16.40 mm.; of elytron, 11.00 mm.; of prothorax (under side?) 2.50 mm.; Width of prothorax, 5.00 mm.; of elytron, near middle, 3.50 mm.

Station number 13 B. Collected by Mrs. Cockerell. The type is in the Museum of the University of Colorado.

A fine specimen, seeming undoubtedly to belong in the neighborhood of *Ceruchus,* thus adding another family to the list of those known to have inhabited the Florissant lake basin. I have named it after an old friend and veteran entomologist, Charles Fuchs, to whom we are indebted for an able and well-illustrated review of the Lucanidæ of North America. I have not described the sculpture of the head and prothorax in the foregoing diagnosis, since the specimen is much more truly an impression than is ordinarily the case, and the chitinous exoskeleton seems to have been almost completely obliterated on those parts of the body. There remains only a granular or subrugose appearance, though the modern American species of the genus are heavily punctured. The abdomen shows five segments.

Aphodius *Illiger.*

A. florissantensis n. sp. Form much like that of the recent *A. granarius* Linn. Head rather large, clypeus slightly truncate at middle, rounded to the sides, angles rounded. Prothorax regularly arcuate at the sides, more strongly narrowed in front, the middle width slightly greater than the basal, apex much narrower than the base. Elytra with deep fairly broad impunctured regular striæ, the striæ duplicate, *i. e.* each one has the edges more deeply impressed than the middle, so as to appear double. Scutellum short. Length, 5.25 mm.; width, 2.25 mm.

Station number 13. Collection number 141. Florissant Expedition, 1906. The holotype is a reverse and is in the American Museum of Natural History.

While this insect fairly closely resembles Dr. Scudder's best figure of his *Atænius patescens,* I cannot refer it to that species on account of several features. In the present specimen the head is much broader, less narrowed anteriorly, the sides of the clypeus more broadly rounded and its apex less so, the clypeal disk without traces of plication. The prothorax is apparently a little longer proportionately, the sides less rounded and the punctuation sparse. Dr. Scudder makes no mention of any such peculiarity of the elytral striation as I have described, though it seems that his number 8147 would have shown it if existent. Further, I prefer to assign the example in hand to *Aphodius* rather than to *Atænius,* the hind tibiæ being broad and apparently ridged.

A. laminicola *Wickh.* A specimen of this species (in reverse) is somewhat better in certain respects than the type, and affords an opportunity for a few remarks. In the example at hand, the clypeus is hardly truncate anteriorly, but rather faintly arcuate. The side of the prothorax (only one side is preserved) is nearly straight except near the front angle, where it is rounded. The scutellum is plainly evident and is of the small type seen in recent species of the genus *Aphodius* proper. The elytral characters are those of the type. In measurements, this specimen is a little less than the type, the total length being only 9.25 mm.

Station 11 or 12. Collection number 39. Florissant Expedition, 1906.

Ligyrus *Burm.*

L. compositus n. sp. Form elongate for this genus, proportionately more so than in our recent *L. relictus.* Head rather short, the clypeus somewhat broadly rounded and slightly sinuate in front, while beyond it is an irregularly arcuate mark which I believe represents the projecting mouth parts, since they sometimes give a similar effect in recent specimens of this genus. Mandibles apparently with a strong external tooth. Eye moderate. The entire upper surface of the head is closely and rather coarsely granulate in the specimen, which, being a reverse, would indicate that

the insect was correspondingly punctured. Prothorax one-third wider than long, distinctly broader at base than at apex, one side (apparently the better preserved) regularly arcuate, the other more nearly straight, front angle acute (on the better side) hind angles somewhat obscured but apparently obtuse and rounded, surface granulated (in reverse) sparsely on the disk but more closely at the sides. Elytra subparallel at sides, each with about twelve rows of granules (in reverse) which indicate corresponding punctures; these punctures rather large and not located in distinct impressed striæ, the interstitial spaces being only moderately well marked off and not geminate but bearing a few scattered granules. Legs short. A fore tibia, which is well exposed, shows two large external teeth, above which can be seen the base of another, probably of similar size, while between the last named and the knee are evidences of three smaller teeth. Both the middle and hind tibiæ show a strong transverse ridge near the middle of their length, in the relative position of a similar ridge in recent species of *Ligyrus*. Middle and posterior tarsi of moderate length, about as in *L. relictus*. Length, total, 16.50 mm.; of head, 2.00 mm.; of prothorax along middle line, 4.50 mm.; of elytra, 9.65 mm.; of fore tibia, 3.50 mm.; of hind tibia, 4.10 mm. Width of prothorax at base, 6.25 mm.; of one elytron about middle, 4.25 mm.

Station number 13 B. Collected at Florissant, Colorado, in 1909 by Willard Rusk. The type, a reverse, is in the Museum of the University of Colorado.

This insect may be placed in *Ligyrus* without violating any of the characters ascribed to that genus. Nevertheless it is apparently a rather composite form, combining the characters of several recent species. In shape, it is not unlike *L. relictus*, though more slender. The elytral sculpture is something like that of certain specimens of *L. ruginasus*, with the strial gemination less marked. The granules of the elytra (and to a less extent those of the prothorax) are evidently reverse impressions of the peculiar mammillate punctures seen on many of the recent species of *Ligyrus*. I find no exact duplication of the toothing of the front tibia, but have not considered this feature of sufficient importance to invalidate the generic reference. The Mexican *L. sallœi* has five tibial teeth, *L. bryanti* has four, while those common in the United States have but three. The pronotum was evidently cracked by pressure, giving, at first sight, the appearance of a median line.

Elaphidion *Serv.*

E. fracticorne n. sp. Preserved in profile. Head moderate, eye strongly transverse and moderately deeply emarginate, the upper lobe a little more than half as large as the lower. Antennæ with basal and apical parts wanting, the intermediate joints four or five times as long as wide, not spinose and only slightly broader at apex than at base. Elytron with the finer sculpture not definable, disk apparently with a fine and not strongly marked costa near the outer margin. Legs with only gradually clavate thighs, tibiæ rather slender and straight. Length, 12.50 mm.; of front femur, 3.75 mm.; of front tibia, 2.75 mm.; of hind tibia, 3.35 mm.; of four antennal joints, (probably the 4th, 5th, 6th, and 7th), 6.25 mm.

Station number 14. Collection number 217. Florissant Expedition, 1906. The type is in the Museum of the University of Colorado.

The apex of the elytra and of the body is broken off, so that the entire length of the insect in complete condition was probably about 2 mm. greater than given above. The general aspect, as preserved, is that of a Podabrid, but the eye, antenna and legs point to a different reference, though the assignment to *Elaphidion* must be considered provisional. Unfortunately the prothorax is in too poor condition to yield any clue to the armament or sculpture.

Callimoxys *Kraatz.*

C. primordialis n. sp. The specimen is preserved in dorsal view, showing the head and trunk, parts of the legs, basal joints of the antennæ, and both pairs of wings, since the hind pair is expanded. Head and prothorax punctured, the former rather finely the latter more coarsely and very densely. Basal antennal joint large and clavate, the others wanting. Prothorax narrowed anteriorly, the sides subparallel from base to about apical third, disk irregular but not alike on both sides, possibly on account of oblique pressure. The appearance is of two dorsal grooves separated by a raised median line, much as in the recent *C. sanguinicollis.* Elytra abbreviated, wedge-shaped, comparatively a little shorter and broader than in *C. sanguinicollis* and more finely punctured, the outer margin broadly darker. Hind wings with the greater part of the venation intact, and so far as exhibited agreeing with that of *C. sanguinicollis,* a similar large brownish spot occupying the area around the end of the long discal cell. Abdomen blackish, the sculpture apparently fine, alutaceous or granulate. Front and hind femora strongly clavate. Length, 9.10 mm.; of elytron, 2.90 mm.

Station number 13 B. There is no collection number, but the specimen is one of the many interesting finds of Mrs. W. P. Cockerell. The type is in the Museum of the University of Colorado.

The genus has not hitherto been recognized in the Florissant fossil fauna, but the assignment seems perfectly safe as far as agreement of characters is concerned.

Colaspis *Fabr.*

C. ætatis n. sp. Preserved in profile. Head obscure, the eye not defined distinctly, but apparently of moderate size and approximately circular, prothorax with the notum slightly arched, elytron somewhat arched posteriorly. Legs and antennæ slender, hind tibiæ straight. The sculpture is obscured by the rather coarse texture of the piece of shale in which the specimen is contained, but the elytron shows traces of strial sculpture near the sutural tip. Length, 8.00 mm.; of elytron, 6.25 mm.; height of body at humerus, 3.00 mm.

Station number 14. Collection number 61. Florissant Expedition, 1906. The type is in the Museum of the University of Colorado.

The generic reference is only an approximation, though the few characters shown, and especially the facies, point to this determination. Differs from *C. luti* Scudd., from the same rocks, in the much greater size.

Diabrotica *Chev.*

D. exesa n. sp. Preserved in part profile. A species is indicated of rather small size and without striking characters, the antennæ moderately stout, the legs a little heavy for this genus. The sculpture is not definable, the elytra showing a number of pitted markings, reminiscent of the ocellate punctures of *Elaphrus*, probably due to the texture of the shale and to decomposition. Length, 5.35 mm.; of elytra, 4.15 mm.; of prothorax, 1.25 mm.

Station number 13. Collection number 123. Florissant Expedition, 1906. The type is in the American Museum of Natural History.

Reliance must be placed mainly upon the measurements for the future determination of this species. It is doubtful if many of the Galerucini can be accurately differentiated as fossils.

Synchroa *Newm.*

S. quiescens n. sp. A specimen showing obverse and reverse is in the collection, the elytra, part of the dorsal portions of the abdomen, the pronotum, head, portions of the antennæ and palpi, together with one leg being fairly well preserved. Body elongate, fairly similar to our recent *S. punctata*. Head rather cuneiform, without visible sculpture, eyes apparently only moderately or scarcely prominent, antennæ with first joint stouter but not entirely exposed, so that the length cannot be determined, second small, about half the length of the third which is slightly narrower and shorter than the fourth, the remainder lost. Maxillary palpi showing three joints, (apparently the second, third and fourth), distinctly serriform, the last joint wider, somewhat securiform, the middle one shorter than either of the other two which are about equal in length. Prothorax evidently distorted, since the sides are asymmetrical, but it is apparently broader at base, tapering slightly with nearly straight sides to the apex, basal and apical margins both straight, hind angles acute, front angles nearly right or slightly rounded. The thoracic width at base is about 1.6 times the length. Elytra spread in the specimen, and (as flattened) conjointly wider at base than the base of the pronotum, slightly broader to behind the middle, gently and regularly narrowing to the subacute tip, surface regularly marked with fine striæ (about eleven) which are finely but distinctly punctured, the punctures separated by about their own diameters, interspaces not visibly sculptured. Seven abdominal segments are visible in dorsal aspect, the proximal four being subequal in length, the others more or less obscured. Length, from front of head to apex of elytra, 18 mm.; of prothorax, 2.5 mm.; of elytron, 12.5 mm.; width of prothorax at base, 4 mm.

Station number R. 13. Collection numbers 219 and 240. Florissant Expedition, 1906. The type is in the Museum of the University of Colorado.

I believe that the generic reference is approximately correct. It is, of course, entirely possible that better specimens may show characters requiring another assignment.

Docirhynchus *Scudd.*

D. culex *Scudd.* Under the number 121, the collection contains a beautiful specimen of this species. It was collected at station 13, and is preserved in almost precisely the same position as Dr. Scudder's example, figured in the volume of Tertiary Rhynchophorous Coleoptera, plate viii, figure 2, and presents the same relative proportions of beak and elytra. The corrugations of the head and granulations of the prothorax are well shown. The middle femur is a trifle more slender at base than the front one, and rather more thickened towards the tip. Both middle and hind tibiæ are straight and of approximately the same length as the anterior pair. The elytra appear to have been weakly striatopunctate. A second specimen, number 261, from the same station, is also placed here with some little doubt, the state of preservation being less satisfactory and the size a little less, though the relative proportions are maintained.

Toxorhynchus *Scudd.*

T. grandis n. sp. Form stout, compact, rather regularly shortly elliptical, but broadest a little behind the elytral humeri. Head small, incomplete but apparently smooth. Prothorax at base as broad as the elytra and continuing their outline, sides rather rapidly and barely arcuately narrowing to apex, basal angles strongly acute, apical ones much less so and possibly rounded at tip. Pronotum rather finely and quite closely granulate and punctate on the disk, the median carina sharp and well marked from base to middle, effaced (perhaps accidentally) anteriorly, basal margin strongly and broadly lobed at middle. Scutellum apparently somewhat longer than broad, but I am not able to make out the anterior limit with certainty. Elytra broader just behind the humeri, each with eight strong fine longitudinal carinæ which are rather weakly broken into granules or catenulations, these carinæ not united in any way but distinct and separate to the elytral margin; interspaces in the form of wide fairly deep grooves, finely punctate and somewhat granulate at bottom. Near the elytral bases are a few strong scattered punctures, arranged without reference to the other sculpture, the carinæ fading out in this region. Length, from front of head to elytral apex 4.50 mm.; of elytral suture, 3.75 mm.; width at broadest part, 3.00 mm.

Station number 7. Collection number 284. Florissant Expedition, 1906. The type is in the Museum of the University of Colorado.

This insect is strongly suggestive of the recent *Pterocolus ovatus* in outline and in some of the sculptural characters. However, I have preferred to place it in *Toxorhynchus*, since it is equally reminiscent of *T. oculatus*

Scudd., from the Florissant shales. This last named species is smaller and has heavier elytral carinæ, lacking also the scattered basal punctures of *T. grandis.* No comparison of rostral characters can be made, since the beak is wanting in the present example which is preserved in dorsal view.

Otiorhynchites *Fritsch* (emend. *Scudd.*).

O. florissantensis n. sp. The specimen consists of obverse and reverse of a peculiar elytron in good preservation, as regards the disk, but somewhat damaged at base and apparently distorted by pressure. The sculpture consists of regular rows of rather large and fairly deep ocellate punctures, the best preserved of which show a central puncture with the impression of a hair or scale still visible. The disk is traversed by four fairly distinct longitudinal costæ, between which the punctures are arranged in sets of three rows each, but towards the side the costæ are less regular and closer together, enclosing but one or two rows. In all there are about eighteen punctured series. Length of elytron, 8.30 mm.; greatest width, 3.20 mm. It is very convex and seems to have had a distinct bulge on the side of the declivity.

Station 14. Collection numbers 213 and 215. Florissant Expedition, 1906. The type is in the Museum of the University of Colorado.

I have used the term *Otiorhynchites* in the same sense as Dr. Scudder, to apply to what seems undoubtedly an Otiorhynchid elytron without characters that would allow of its being definitely referred to any genus with which I am acquainted.

Cyphus *Germ.*

C. subterraneus n. sp. Comparable with the recent *C. lautus* Lec., but smaller. Beak short, with intricate fine granulate sculpture, longitudinally disposed, probably due chiefly to the imprint of scales, the median line fine but distinct, extending from near the tip of the rostrum to a point slightly posterior to the anterior margin of the eyes. Eye moderate and nearly circular, but, as preserved, showing a spur-like projection from the upper posterior margin, probably due to distortion. Prothorax coarsely subrugosely longitudinally sculptured at sides, about smooth, excepting scale marks, on the disk, sides regularly gently arcuate, base nearly straight. Elytra less parallel-sided than *C. lautus,* each showing about eight well-marked fine ridges, bearing regularly spaced subcircular or slightly elongate small granules, these ridges and granules indicating that the elytra were correspondingly finely striate and punctate. Front femur (all that shows of the legs) only moderately and gradually thickened. Length, over all, 8.75 mm.; of elytron, 5.00 mm.; of prothorax, 1.85 mm.; of rostrum, to eye, about 0.75 mm. Width of rostrum, about middle 1.15 mm.; of prothorax at middle, 2.25 mm.; of elytra, conjointly, about middle, 3.85 mm.

Station number 7 A. Collection number 235. Florissant Expedition, 1906. The type is a reverse and is in the Museum of the University of Colorado.

Nothing at all similar to this insect has been described by Dr. Scudder; it seems to agree well with the genus in which it is here placed.

Geralophus *Scudd.*

G. antiquarius *Scudd.* Five specimens, all from station 14. Collection numbers 85, 104, 177, 180 and 251.

G. occultus *Scudd.* One specimen, station 14. Collection number 43. Another from station 13, collected by S. A. Rohwer.

G. repositus *Scudd.* One specimen, referred here with some doubt, comes from station 11. Collection number 247.

G. scudderi n. sp. Above medium size. Head granulate, apparently with fine punctures intermixed, beak, in profile, almost absolutely straight, sculptured like the head, the sides parallel to near the tip where they diverge slightly and thence converge to the extreme apex, thus forming a slight rostral dilatation. Prothorax finely granulate and obliquely substrigose. Elytra finely and distantly striatopunctate, the bristles mostly removed, but from the few that remain it is evident that they were separated by about their own lengths. Femora stout. Length, excluding rostrum, 7.00 mm.; of rostrum, 1.85 mm.; of prothorax, on chord of the dorsal arc, 1.85 mm. Width of beak at middle, 0.50 mm. Height of body, 3.5 mm.

Station number 14. Collection number 11, Florissant Expedition, 1906. The type is in the Museum of the University of Colorado.

By description, this would come nearest *G. repositus* Scudd., common in the same shales; but the figure shows that species to have had a much coarser punctuation and thicker beak.

G. lassatus *Scudd.* Four specimens, stations 11, 13 and 14. Collection numbers respectively 224, 148, and 6. The other example was collected in 1909 and has neither station nor collection number.

G. fossicius *Scudd.* A specimen without station or collection number, taken in 1908, is referred here, but shows only the ventral surface.

Apion *Hbst.*

A. cockerelli n. sp. Preserved in profile, giving a good view of the head and beak, prothorax, one elytron and part of the legs. General outline pyriform, as in most of the species of *Apion*, rather slender. Head, exclusive of the rostrum, nearly as long as the prothorax, not rapidly narrowing anteriorly but tapering gradually and almost imperceptibly into the beak. Rostrum rather stout and only slightly bent. a trifle enlarged just before the tip, antennæ inserted about two-fifths from the base, Eye somewhat remote from the prothoracic margin. Prothorax longer on the dorsal than on the ventral aspect, with some evidence of coarse variolate punctuation laterally. Elytra broadest behind the middle, moderately declivous behind, striæ very wide and deep, interspaces strongly convex and rather broad, apparently finely irregularly punctate. Legs rather slender, the front femur not at all strongly clavate. Length, including rostrum, 2.70 mm.; of elytron, 1.32 mm.; of prothorax, .45 mm.

Station number W. 9, L. Collection number 255. Florissant Expedition, 1906. The type is in the American Museum of Natural History.

A species not differing greatly in size and form from the recent *A. melanarium* Gerst., but with less clavate thighs and much stronger and broader elytral striæ and more convex interstices. I am not sure of the punctuation of the elytral striæ, but the outer ones at least appear to be marked with widely separated large punctures. In comparison with the described fossil species from Florissant, it comes nearest in size to *A. pumilum* Scudd., which is of a different shape.

Cleonus *Schönh.*

C. rohweri n. sp. Preserved in part profile, the elytra flattened and overlapping along the suture, so that the characteristic outline of this genus is lost. Rostrum short and thick, nearly straight, but apparently the head is twisted at the articulation with the thorax, so as to give an oblique view. Eye transverse. Prothorax short, coarsely and irregularly punctured on the disk, finely granulate and punctate on the sides. Elytra with strongly marked series of elevations representing rows of distinct nearly circular punctures in regular shallow sub-equidistant striæ, the exact number of which is indeterminable but is not less than eight. These punctures are separated by their own diameters, or a little less. Interspaces flattened and without definite sculpture, other than a fine granulation which may be due to the marks of scales. Legs of moderate length, anterior and middle femora stout, but not excessively so, front tibiæ distinctly curved. Length from front margin of pronotum to tip of elytra, 10.25 mm.; of prothorax, 2.00 mm.; of beak, about 1.75 mm.

Station number 14. Collection numbers 71 and 88, both representing the same specimen. Florissant Expedition, 1906. Received from Professor Cockerell and named for Mr. S. A. Rohwer, one of his associates on this expedition. The type is in the Museum of the University of Colorado.

The middle femur looks as if it had a distinct rather large triangular tooth beyond the middle, but I believe this appearance is due to a bit of vegetable debris under and projecting from it. In comparison with Dr. Scudder's fossil species, it comes nearest to *C. exterraneus* in size, but differs in having transverse eyes and by the more approximate punctures of the elytral striæ.

Magdalis *Germ.*

M. striaticeps n. sp. Comparable to the recent *M. armicollis*, if allowance is made for flattening. The specimen is preserved so as to show parts of the dorsal and ventral aspects (*i. e.*, not in profile as are most of the weevils) but is partly disintegrated so that the principal sculptural features are lost, as well as the legs and antennæ. The most striking characteristic is shown in the marking of the underside of the head, which is provided with many distinct transverse strigosities, extending quite from side to side, reproducing the similar but less distinct striæ on *M. armicollis* and *M. olyra*, or even more closely those of *M. barbita*. This part of the under side is in reverse, and shows, on the beak, a distinct sharp median longitudinal ridge,

representing the corresponding groove of *M. olyra.* Eyes about as in *M. olyra.* Thoracic outline not perfectly preserved, but I see no evidence of gross serrations on the best side, though the other is irregular. The hind angles appear not to have been strongly laminate, but are somewhat obscured. What little remains of one elytron in good enough preservation for study shows a trace of a line of moderate-sized close-set rounded punctures, something like the strial series in *M. lecontei.* Length, including the rostrum which continues the median axis of the body, 7.00 mm.; of rostrum, from eye to tip, 2.10 mm.; of head and prothorax, from front of eye to thoracic base, 1.65 mm.

Station number 13. Collection numbers 256 and 195. Florissant Expedition, 1906. The description is made from the first specimen, which, though not all on the same level, is at least partly a reverse, number 195 being the other half of the same insect. The type is in the Museum of the University of Colorado.

Differs from *M. sedimentorum* Scudder (described from the Florissant shales) in the coarser elytral punctuation as well as in being more than twice as large. Too much reliance should not be placed upon the latter character, however, since the recent species of *Magdalis* vary widely in size.

Ceutorhynchus *Germ.*

C. clausus *Scudd.* I have referred here, a specimen from Station number 4, collection number 162, in very soft shale which seems not to have been subjected to much pressure, since the insect is not flattened so much as usual but projects from the matrix quite strongly. It is preserved in profile and shows the scales of the under surface to have been large and rounding, something like those of the recent *Phytobius griseomicans.* Although I have assigned the specimen to Dr. Scudder's species cited above, I doubt the generic reference, but have not found a more satisfactory place for it.

Balaninus *Germ.*

B. restrictus *Scudd.* A single specimen, in only fair condition, is in the collection and shows the under surface. The coarseness of the piece of shale in which it is preserved, together with some disintegration of the integuments, render any description of the ventral plates impossible. This example is a little longer than Scudder's unique, measuring 8.00 mm., exclusive of the rostrum which is 3.65 mm. in length.

Station 14. Collection number 74. Florissant Expedition, 1906.

B. minusculoides n. sp. Resembles *B. minusculus* Scudd. (from the Florissant shales). Beak nearly straight from the base for about half its length, thence regularly but not strongly arcuate, head finely granulate, eyes relatively small (in comparison with the recent *B. baculi* Chitt.) and, as preserved, strongly transverse.

Prothorax tapering, transversely granulato-strigose, this appearance perhaps due in part to hair impressions. Elytra with strong, sharply defined catenate ridges, which indicate impressed, distinctly punctured striæ in which the punctures were elongate, separated by about their own length on the basal portions of the disk, but becoming more nearly circular and comparatively more distant towards the tip. Legs not showing any of the femora in entirety, but the visible tips indicate that they were strongly clavate near the apices. The only tibia showing, a posterior one, is slender and about straight. Length, exclusive of rostrum, 5.75 mm.; of rostrum, on chord of arc, 2.75 mm.

Station 14. A single specimen, in reverse, numbered 34, collected by Mrs. Cockerell. Florissant Expedition, 1906. The type is in the Museum of the University of Colorado.

Comes nearest to *B. minusculus* Scudd., but is larger, the beak more elongate and the elytra differently sculptured. The antennal scape is folded back, but does not attain the eye; the remaining portion of the antenna, though the slender club seems incomplete, is about 1.50 mm. long.

B. minusculus *Scudd.* Represented by a single reverse, in beautiful condition except that the beak is missing. It is just the size of Dr. Scudder's type, has a finely and densely punctured prothorax, and the elytral striæ (represented of course by ridges) are sharp with fine, widely separated punctures.

Station 13 B. No collection number. Florissant, 1908.

Scyphophorus *Schönh.*

S. tertiarius n. sp. Body stout, head twisted but not retracted in the specimen, beak rather slender, not showing a basal dilatation, though this may be due to the angle at which it lies, since the tip is not in the same plane as the rest of the remains. Prothorax near the base as broad as the elytra, widest a little in front of the broadly rounded hind angles, thence slightly narrowed to about three fourths, whence the convergence is much more rapid to the tip. No definite sculpture can be made out on either the head or the thorax. Elytra subparallel to about the middle, thence narrowing to tip, each with nine very fine impressed apparently impunctate regular striæ, subequidistant upon the disk but more approximate towards the sides, interstitial spaces broad and flat, not visibly sculptured. Pygidium exposed, sculpture not evident. The plates of the underside are fairly well marked, and are best described by the measurements which follow. Length of specimen, from front of head to tip of abdomen, 14.75 mm.; of head, 1.75 mm.; of beak, 3.50 mm.; of prothorax along median line, 3.75 mm.; of elytra, 8.00 mm.; of metasternum along median line, 2.65 mm.; of first abdominal segment at middle, 1.60 mm.; of second, 1.40 mm.; of third and fourth united, 1.40 mm. Width of prothorax at broadest point, 6.35 mm.; of elytra at broadest point, 6.35 mm.; of prosternum between coxæ at narrowest point, 0.575 mm.; of mesosternal process between coxæ, 1.25 mm. Distance between points of posterior coxal cavities, about 1.25 mm. Longitudinal diameter of anterior coxal cavity, 1.50 mm.; transverse diameter, 1.75 mm.

Station number 14. Collection numbers 110 (obverse) and 159 (reverse).

Florissant Expedition, 1906. Collected by Mrs. W. P. Cockerell. The type is in the American Museum of Natural History.

The specimen is in fair preservation as regards the body, but antennæ and legs are wanting, thus failing to show characters necessary for exact generic determination. I believe that the insect was at any rate closely allied to our recent Scyphophori, with which it agrees quite well in proportional measurements of the ventral sclerites. The prothorax, however, is relatively broader (due perhaps to flattening) though otherwise similar in outline, and the same remark may be applied to the elytra. The elytral striæ are fine, like those of *Cactophagus validus*, and this feature, as well as the shape of the prothorax and the size will serve to differentiate it from the two fossil species described by Scudder.

Cratoparis *Schönh.*

C. adumbratus n. sp. The specimen is a reverse in profile. Head finely granulate, rugose on the side, beak short with a distinct, rather sharp median groove extending on to the vertex, antennæ deficient, only one being left, which is defective at base, but apparently about equal in length to the head and prothorax, terminated by a distinct three-jointed club, of which the first and second joints are about equal, the last a little longer and pointed at tip. Prothorax finely, closely granulate on the disk. Elytron with regular rather distant rows of fine circular granules separated longitudinally by about their own diameters. Front coxæ rounded, legs moderately stout, abdominal segments subequal. Length, 8.75 mm.; of elytron, 6.50 mm.

Station W. 9, L. Collection number 113. Florissant expedition, 1906. The type is in the Museum of the University of Colorado.

Much larger and more finely sculptured than *C. arcessitus* Scudd., from the Florissant shales. It also slightly exceeds the measurements of the recent *C. lunatus*, which is a more coarsely sculptured insect with a somewhat larger antennal club. In applying the above description it must be borne in mind that since the characters refer to the reverse or cast, the granules and groove there mentioned represent punctures and carina in the insect itself.

Hylesinus *Erichs.*

H. extractus *Scudd.* One specimen, in rather poor condition, taken at Florissant, but without station or collection number, is assigned here. It is a little larger than the type, measuring a full two millimeters in length.

56.57(78.8)

Article VI.— FOSSIL INSECTS FROM FLORISSANT, COLORADO.

By T. D. A. Cockerell.

Plate III.

COLEOPTERA.

Paussopsis n. gen. (Paussidæ ?)

Small beetles apparently belonging to the Paussidæ; general form much as in *Pentaplatarthrus* (*cf.* Ants, by W. M. Wheeler, p. 399, fig. 236 D), but antennæ with at least seven, probably eight, joints; elytra reaching nearly to end of abdomen; thorax broader than long; femora thick, but tibiæ not remarkably stout.

Paussopsis nearctica n. sp.

Length about 5½ mm.; face and antennæ dark brown; hind part of head, thorax, femora and abdomen ferruginous; elytra and tibiæ dark brown or black; thorax 1 mm. long, and about 1½ wide; elytra 3½ mm. long and apparently little over 1 mm. wide, parallel-sided, without evident sculpture. The following measurements are in microns: width of last antennal joint 460, of penultimate joint 475; length of penultimate joint 270; length of anterior femur about 865, its width about 320; width of anterior tibia 160; length of hind femora about 1270.

Miocene shales of Florissant, Station 13 B (S. A. Rohwer).

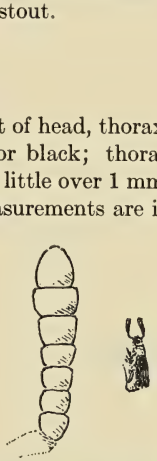


Fig. 1. *Paussopsis nearctica.*

The Paussidæ are a family of remarkable myrmecophilous beetles, occurring in the old world, with the exception of two species in South America. Although they are highly specialized, they are of considerable antiquity, species having been described by Motschulsky (1856), Stein (1877) and Schaufuss (1896) from Baltic Amber. While I believe the beetle now described is a Paussid, the actual demonstration of its relationships seems impossible, as the tarsi and other important characters are not clearly visible. Granting it to be a Paussid, it will stand near the African *Pentaplatarthrus*, differing by the greater number of antennal joints. Unfortunately, the supposed basal joint cannot be clearly made out, but from the position of the antennæ, and analogy with living forms, there can be little or no doubt that there was a more or less elongate joint, something like the first joint in *Paussus dama*. Although the Paussidæ are mainly tropical or subtropical, the presence of a species at Florissant cannot be used as an argument in favor of a tropical Miocene climate at that place, since at the present time *Paussus favieri* occurs as far north as the south of France.

Chrysobothris gahani n. sp. (Buprestidæ.)

♂. Length about $10\frac{2}{3}$ mm.; width of thorax slightly over 3 mm., of abdomen in middle nearly 4; elytra about 8 mm. long and $1\frac{3}{4}$ wide, closely and finely punctured, not at all striate; thorax with fine vermiform sculpture, its sides convex; abdomen with strong sublateral sulci, about half a mm. from margin. Black, last abdominal segment ferruginous; elytra appearing black in one impression, but in the reverse warm light brown with strong metallic (greenish and pinkish) tints, the margins narrowly dark; legs, so far as visible, black; wings warm brownish, darker along costa. I figure what can be seen of the venation, and also the genitalia. The posterior corners of the thorax seem to have curious round outstanding knobs, quite different from anything I could find described, but closer study shows that these are nothing but the ends of the femora, standing out as they often do in living species.

Miocene shales of Florissant (Willard Rusk and Terry Duce, 1909).

I am greatly indebted to Mr. C. J. Gahan of the British Museum for advice on this insect. After examining sketches I sent him, he expressed the opinion that it must be near *Chrysobothris*, and upon comparing it with a recent specimen of that genus, I cannot detect any difference of generic value. Mr. Gahan remarks that *Chrysobothris* has fine denticulation along the outer and apical border of the elytra, apparently wanting in my insect. I have quite failed to find any trace of this in *C. gahani*, but in the living species it may be exceedingly minute and obscure. I also fail to find any subapical lateral denticulation of the abdomen, such as occurs in many *Chrysobothris*. The form of the head and thorax appear normal, and the elytra were evidently metallic. In the wings, the angle formed at the junction of the media and cubitus is much more acute than in a recent *Chrysobothris* examined, but the double cubitus exactly agrees.

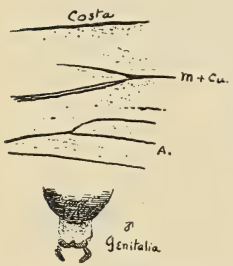


Fig. 2. *Chrysobothris gahani.* Part of venation and genitalia.

The only other Florissant Buprestid, *Chrysobothris haydeni* Scudder, is half as large again.

HYMENOPTERA.

Palæovespa scudderi *Cockerell.* (Vespidæ.)

A well preserved anterior wing, collected by Mr. S. A. Rohwer, is about 15 mm. long, length of first discoidal about $6\frac{3}{4}$, of marginal cell about $3\frac{3}{4}$ mm. The following are approximate measurements in microns: upper end of b. n. from stigma 480; second s. m. on marginal 450; third s. m. on marginal

1010; lower side of marginal beyond third s. m. 1410; third discoidal on second s. m. 800; second s. m. from insertion of second r. n. to apical corner 420; lower side of third s. m. 1190; lower end of basal nervure basad of t. m. 270. The various specimens attributed to this species differ in size, but not more so than modern *Vespa.*

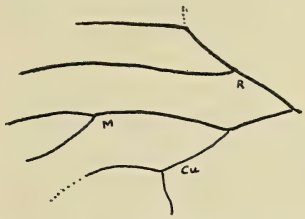


Fig. 3. *Nicropsylla rigidula.* Venation.

In the insertion of the recurrent nervures *Palæovespa* resembles *Polybia,* but in *Polybia* the cubital nervure is very little deflected to meet the first recurrent, so that the end of the first discoidal cell is much more oblique than in *Palæovespa.* The abdomen of *Polybia* is quite unlike that of *Palæovespa.*

Andrena grandipes n. sp. (Andrenidæ.)

♀. Length 13½ mm.; anterior wing 9½ mm.; width of head 4 mm., of abdomen 5; head and thorax black; abdomen broad, reddish-brown, the hind margins of the segments very broadly pallid; antennæ thick, not very long; facial quadrangle longer than broad, distance between eyes only about 1⅓ mm.; ocelli normal, in a curve; cheeks large apparently swollen; mandibles long, about 448 μ broad, bidentate, the apical tooth very obtuse; malar space apparently about ¾ mm. long; eyes small, about 1600 μ long and 576 broad; wings clear, hairy, especially along veins; stigma dark brown, very hairy; legs stout, dark reddish-brown, hind tibia and basitarsus densely covered with coarse dark hair; hind tibia very broad (breadth about 1360 μ), about 3½ mm. long; its basitarsus short and broad, about 2 mm. long; venation in general normal for *Andrena,* but marginal cell very long and narrow, ending in a point on costa; stigma large but narrow; b. n. meeting t. m.; t. m. oblique, the lower end most apicad; third s. m. long, much longer below than above.

The following wing-measurements (anterior wing) are in microns: —

Length of marginal cell, from its very acute basal angle to apex	2832
Breadth (depth) of marginal cell	480
Basal nervure on first submarginal cell	560
Basal nervure on first discoidal cell	849
Length of transversomedial nervure	448
Length of first s. m. (lower basal to upper apical corner)	1600
First s. m. on marginal	256
Second s. m. on marginal	512
Third s. m. on marginal	528
First discoidal on second s. m.	528
Third discoidal on second s. m.	400
Length of third s. m. below	960
Second discoidal on third (the second r. n. arising below middle)	640
Length of first discoidal	2720

The hind wing is also visible, and is normal. I have taken two measurements: —

Median cell on marginal	1088
Upper end of t. m. to base of discoidal cell	992

Hab.— Miocene shales of Florissant, Station 13 (T. D. A. Cockerell, March, 1911).

This agrees closely with modern *Andrena* in most respects, but is peculiar for the very broad hind tibia and basitarsus, the small eyes and the long slender marginal cell. The upper end of the second recurrent nervure cannot be clearly made out, but its lower part is visible, and it evidently must end some distance before the end of the third s. m., as in *Andrena.* In the table in Bull. Mus. Comp. Zoöl., June 1906, p. 36, it runs to 2, and runs out because the first r. n. is received by second s. m. beyond the middle, and the wing is over 7 mm. long.

Eriocampa synthetica n. sp.

♂. Length 7 mm., anterior wing 5 mm.; head and thorax black; abdomen dark fusco-ferruginous; wings clear, nervures dark, costal cell entirely fuscous. Anterior wings with cross-nervure of marginal cell oblique, arched, bent in middle (as in *Pseudosiobla*); cubital nervure bent upwards at base, separated by a little interval from basal (as in *Strongylogaster*); basal nervure not at all bent; externo-medial nervure as in *Eriocampa ovata* (not modified as in *E. wheeleri*); second s. m. on marginal much longer than first s. m. on first discoidal, yet not nearly twice as long;[1] third s. m. on marginal about twice as long as first on first discoidal; lanceolate cell strongly contracted (yet not so much as in *E. ovata*) and with a very oblique cross-nervure; sides of first discoidal cell, formed by basal and first recurrent nervures, parallel or almost so.

Hind wing with the median and discal cells apparently not at all closed apically, but the strong transverse veins really run around the wing margin, exactly as in male *Eriocampoides*, though the subcostal cell is narrowed and sharply truncated at apex, as Macgillivray figures for female *Eriocampoides*. The lanceolate cell of the hind wings is slender, its width about 240 μ. According to the hind wing, the insect belongs to Phyllotominæ, but the anterior wing is that of Emphytinæ. Although the sides of the first discoidal cell (anterior wing) are parallel, the basal side (basal nervure) is longer (length 640 μ) than the apical (length 512 μ), in the manner of *E. wheeleri*, and departing from the condition of true *Eriocampa* in the direction of the Phyllotomines. The transversomedial nervure is more oblique than in *E. ovata.* The third t. c. is slightly arched inwards.

---

[1] In Rohwer's table (Bull. Amer. Mus. N. H., XXIV, p. 592) it is stated that in *E. wheeleri* the second cubital on radial is no longer than first on cubitus; it should read "not greatly longer than," as the measurement of the first s. m. in the original description is diagonal. The character validly separates *wheeleri* from *scudderi* and *bruesi*, and associates it with *synthetica* and *pristina*.

The following measurements are in microns: —

Length of marginal cell	2144
End of stigma to end of marginal cell	1376
Upper end of third s. m. to end of marginal	672
Second s. m. on marginal	608
Third s. m. on marginal	784
Lower end of marginal cross-vein to end of third s. m.	192
First s. m. on first discoidal	400
Second s. m. on first discoidal	224
Second s. m. on third discoidal	560
Third s. m. on third discoidal	128
Lower end of b. n. to upper end of t. m.	368
Length of t. m.	384

Hab.— Miocene shales, south end of Fossil stump Hill, Florissant (W. P. Cockerell, March, 1911).

Close to *E. wheeleri,* but differing by the smaller size, the form of the transverse marginal nervure and the externomedial, and other details shown by the measurements. It is probable that this species should stand as the type of a new genus, to which *E. wheeleri* could also be referred. From *E. pristina,* the new species is known by its much smaller size and the various details of the measurements.

HEMIPTERA.

Necropsylla rigidula n. sp. (Psyllidæ.)

Length about 2 mm.; anterior wings a little over $1\frac{1}{2}$ mm., hyaline, with strong dark veins; venation normal for the genus. The venation is much like that of the Australian *Creiis longipennis* Walker, R_1 having the same bend, and the cell in the fork of the radius having the same form, with parallel sides; R_1 beyond the bend also is widely separated from the costa, and the radial fork is a little *basad* of the mediocubital fork, a character which readily separates the genus from *Psylla.* In the *Creiis,* however, the fork of the media is at the same level as that of the cubitus, whereas in our insect the media forks about 260 μ apicad of the fork of cubitus. In the *Creiis* the lower branch of the cubitus is oblique, in our species it is vertical or transverse, even directed slightly basad. The shape of the cell in the fork of the cubitus is much as in *Psylla,* except that it is longer. The cell in the fork of the media is quite long (about 435 μ), and widely open; the radial sector curves upward a little at end; from the radius (R_1) to the radial sector is about 130 μ, from the latter to the media about 145.

Miocene shales of Florissant (Geo. N. Rohwer); on the same piece of shale as the type of *Taracticus renovatus,* and only about 3 mm. from it.

Miocene shales of Florissant (Geo. N. Rohwer); on the same piece of shale as the type of *Taracticus renovatus,* and only about 3 mm. from it.

This is about a third smaller than Scudder's *N. rigida,* and appears to be distinct, but it is just possible that the difference is merely sexual.

Cicada grandiosa Scudder. (Cicadidæ.)

This species was based by Scudder on a hind wing, which was remarkable for its large size, and supposed to differ from true *Cicada* in several venational characters. The wing, however, agrees very nearly with that of the living American *Cicada marginata,* and I believe represents a quite typical *Cicada.* In March, 1911, my wife and I found at the south end of Fossil Stump Hill, Florissant, a rather poorly preserved upper wing of *Cicada,* showing all the central area, including the forking of the radius and cubitus, the median cell and the two large discal cells above it. All this is perfectly typical for *Cicada,* and might almost have come from a wing of *C. marginata.* The large cell in the forks of the media has its side on the cell (median) below 12 mm., and that on the cell above 10 mm. As the proportions agree excellently with the upper wing which should go with Scudder's hind wing, it seems safe to assume that they belong to the same species.

DIPTERA.

Leia miocenica n. sp. (Mycetophilidæ.)

Length slightly over 4 mm., wing 3; pale brownish, the first six abdominal segments with the apical third or rather less dark fuscous, apex of abdomen fuscous; wings hyaline, not hairy; antennæ thick, normal for the genus in appearance, but I think I can count at least 18 joints, though this is not positive; legs slender, hind tibia with tarsus a little over 3 mm.; claws simple; thorax arched; none of the wing-veins bristly. Wing in general like that of *Leia*; the measurements given are in microns.

End of auxiliary vein to end of first	960
Origin of third vein from first (according to authors) to end of first	320
Anterior cross-vein of authors	510
Fourth vein from basal end of "cross-vein" to fork	400
Fork of fifth vein from base of wing, about	800
Fork of fifth vein basad of level of fork of fourth	290
At level of end of first vein:—	
Distance from first to third	80
Distance from third to fourth	290
Distance between branches of fourth	175

This has the Sciarine feature of the so-called anterior cross-vein being in a perfectly straight line with the so-called second division of the third vein, although at its point of origin from the fourth vein the cross-vein makes with it a distinct angle above. The other characters, as the fork of the

fifth vein being remote from the base of the wing, the auxiliary vein being distinct, etc., are Mycetophiline. *Leia* Meigen (*Neoglaphyroptera* O. Sacken) appears to be a genus connecting the Sciarinæ and Mycetophilinæ, and it is certainly of great antiquity, being represented by many species [1] in the Oligocene of Europe. Compared with *Leia nitens* (*Neoglaphyroptera nitens* Williston), as figured by Williston, our species differs conspicuously in the absence of sinuosity in the third vein, and the lack of hairs or bristles on the basal part of fourth vein, "cross-vein," and apical part of third.[2] It also differs in the fork of the fifth, which is complete basally, the upper branch joining the lower at a rather large angle, owing to a bend at its base. Meunier has described a genus from Baltic amber as *Proneoglaphyroptera*, and since it has the veins free from bristles, and the venation in general almost exactly like that of our Florissant species, I have hesitated whether to place the latter in it. However, the antennæ of Meunier's genus are much more slender, and it is perhaps even doubtful whether his insect should really be separated from *Leia*. If *Proneoglaphyroptera* is maintained, the reference of *L. miocenica* to it may yet prove necessary. Miocene shales of Florissant (Geo. N. Rohwer.)

Plecia melanderi n. sp. (Bibionidæ.)

Plate III, Fig. 1.

♂. Length about 7⅔ mm.; wing 6 mm.; ferruginous, the slender abdomen with a pallid band on each segment posteriorly; wings reddish hyaline. Venation as usual in the genus, except that the distance from the anterior cross-vein to the forking of fourth is rather *greater* than the length of the cross-vein (the reverse being true of recent *Plecia* examined). The apex of the second basal is so faint that I cannot be sure of the upper nervure, separating the second basal from the third posterior, but it seems to be more oblique than in the living species. The following measurements are in microns:—

Depth of marginal cell at level of anterior cross-vein	290
Depth of submarginal cell at level of end of second vein (so-called anterior branch of third)	160
Distance from end of second vein to end of third	1040
Distance in a straight line from base of marginal cell to separation of second vein from third (so-called fork of third)	2015

[1] These are the following, described as *Glaphyroptera* and *Neoglaphyroptera*: *Leia curvipetiolata* (Meunier), *L. longipetiolata* (Meunier), *L. crassipalpis* (Meunier), *L. longipalpis* (Meunier), *L. gracillima* (Förster), *L. longipes* (Förster), *L. crassiuscula* (Förster).

[2] The course of the pilosity in *L. nitens*, as figured by Williston, may be used as an argument against the idea that the vein connecting the apical part of the third with the stem of the fourth is a cross-vein. (See the discussion in Canadian Entomologist, 1908 pp. 421–422; the insect there described is however a female, not a male, as Dr. Felt points out to me). The pilosity follows what I suppose to be the real course of the third vein (united basally, with the fourth).

Miocene shales of Florissant. Named after Prof. A. L. Melander, who first called my attention to the occurrence of *Plecia* in the Florissant shales. The genus is still found in the same region; *P. heteroptera* Say occurs at Colorado Springs.

It is to be remarked that the character of the lengthening of the stem of the fourth vein beyond the anterior cross-vein is even more pronounced in *Plecia similkameena* Scudder, fossil in British Columbia. *P. melanderi* is smaller than any of the three fossil species of *Plecia* described by Scudder.

Symphoromyia subtrita n. sp. (Leptidæ.)

Plate III, Fig. 2.

♀. Length 10 mm.; wing 7; robust, looking like a Muscid (Verrall remarks that the living *S. crassicornis* has the appearance of an *Anthomyia*); ferruginous, darker above; abdomen with scattered minute hairs; legs very finely pubescent; proboscis slender. Venation as figured by Verrall (British Flies, V, p. 299) for *S. immaculata*, except in some slight particulars; thus the second submarginal cell in the fossil is much less broadened apically. The characteristic form of the marginal cell, the position of the anterior cross-vein, the long præfurca, the open anal, etc., are all normal. The following measurements are in microns:—

Marginal cell on costa	290
Length of second submarginal	3360
Length of second posterior	2400
Width of anal at level of second basal	830
Width of first posterior near end	625
Width of second posterior near end	610
Width of third posterior near end	675
Length of præfurca, about	1440
First basal on first submarginal	850
First posterior on first submarginal	1200

Miocene shales of Florissant, station 14 (Wilmatte P. Cockerell.)

Verrall remarks of this genus: "Osten Sacken has stated that the females of a Californian species bit him quite painfully and drew blood like a *Tabanus*, and though there is no other well authenticated case of a Leptid biting, the statement of such a dipterologist as Osten Sacken is beyond doubt, and as some confirmation Bezzi has recorded that the female of *S. grisea* settled on his hands as if intending to attack him."

The genus *Symphoromyia* is well represented in the modern fauna of Colorado, with the following species: *S. fera* Coquillett, *S. pachyceras* Williston, *S. flavipalpis* Adams, *S. pullata* Coquillett. The whole palæarctic region has only the same number of recorded species.

Asilus amelanchieris n. sp. (Asilidæ.)

Length about 21 mm., wing 11 mm.; general structure and appearance as in *Asilus*; black, the abdominal sutures broadly pallid, legs apparently ferruginous, the tarsi darker; venation ordinary, marginal cell closed; five posterior cells, the fourth closed some distance from margin; anal cell closed just before margin.

In my description of the Florissant fossil *Asilus peritulus* (Bull. Am. Mus. N. H., 1909) I made comparisons with *A.* (*Tolmerus*) *notatus* Wied, and it is convenient to do the same here. *A. amelanchieris* differs from *A. notatus* thus:

(1.) Apex of marginal cell more acute, but lower nervure evidently curved subapically, the form being precisely that of *Asilus crabroniformis*.

(2.) Second submarginal cell slightly over 3 mm. long, its base a little over 2 mm. from anterior cross-vein; thus proportionately it is longer than in *A. notatus*, but not nearly so much so as in *A. peritulus*. The shape of the second submarginal is nearly as in *A. notatus*, but it is more contracted subapically (its width at most contracted place is about 450 μ, at widest part toward base about 695; at extreme apex it flares widely, and is even a trifle wider than toward base.)

(3.) The third posterior, which in *A. peritulus* differed from *A. notatus*, is here of the *notatus* type, the sides of the second posterior being nearly parallel.

(4.) The anterior cross-vein is conspicuously beyond middle of discal cell (2400 μ from base, 1520 from apex.)

(5.) The fourth posterior, which in *A. peritulus* differed from *A. notatus*, is here about as in *notatus*.

The legs have fine hairs and strong spines as in *A. notatus*, but the spines are fewer and rather shorter; on the hind tibia only three spines are visible, all in the apical region. The hind femur is shorter than in *A. notatus*, reaching only to end of basal third of third abdominal segment; it is about 5 mm. long, its tibia about 4 mm.

The venation, compared with *Asilus crabroniformis*, shows the following differences:

(1.) The lower apical corner of fourth posterior cell is a little more apicad than upper apical corner; in *A. crabroniformis* the upper apical corner is more apicad.

(2.) The second posterior cell does not bulge at the upper basal corner.

(3.) The oblique basal side of discal cell is straight.

(4.) The second submarginal is more contracted subapically.

Miocene shales of Florissant, partly overlapping a leaf of *Amelanchier peritula* Ckll.

Taracticus renovatus n. sp. (Asilidæ.)

Length about 10 mm., wing 6; a better *Taracticus* than *T. contusus* (Bull. Amer. Mus. N. Hist., XXVIII, p. 282), the lack of hair, general form, and strong dark veins, being very characteristic, also the wide second submarginal cell. The width or depth of the second submarginal, 320 μ from the end, is 480 μ, whereas in *T. contusus* at this point it is only about 260. The femora are evidently more robust than in the living *T. octopunctatus*, and the abdomen (in lateral view) is not at all constricted subbasally. The anterior cross-vein is beyond the middle of the discal cell, and the second posterior on the discal is only half as broad as the third. The following measurements are in microns:—

Length of second submarginal cell	1840
First posterior on first submarginal	1040
First posterior on margin	500
Second posterior on discal	160
Second posterior on margin	500
Third posterior on discal	320
Third posterior on margin	770
Fourth posterior on margin	450
First posterior on discal	720
First basal on discal	910
Second basal on discal	430
Marginal on margin	720
Subcostal on margin	1440

The last two measurements are inexact owing to the very gradual merging of the first vein into the margin. The lower part of the anal cell is not preserved.

Miocene shales of Florissant (Geo. N. Rohwer).

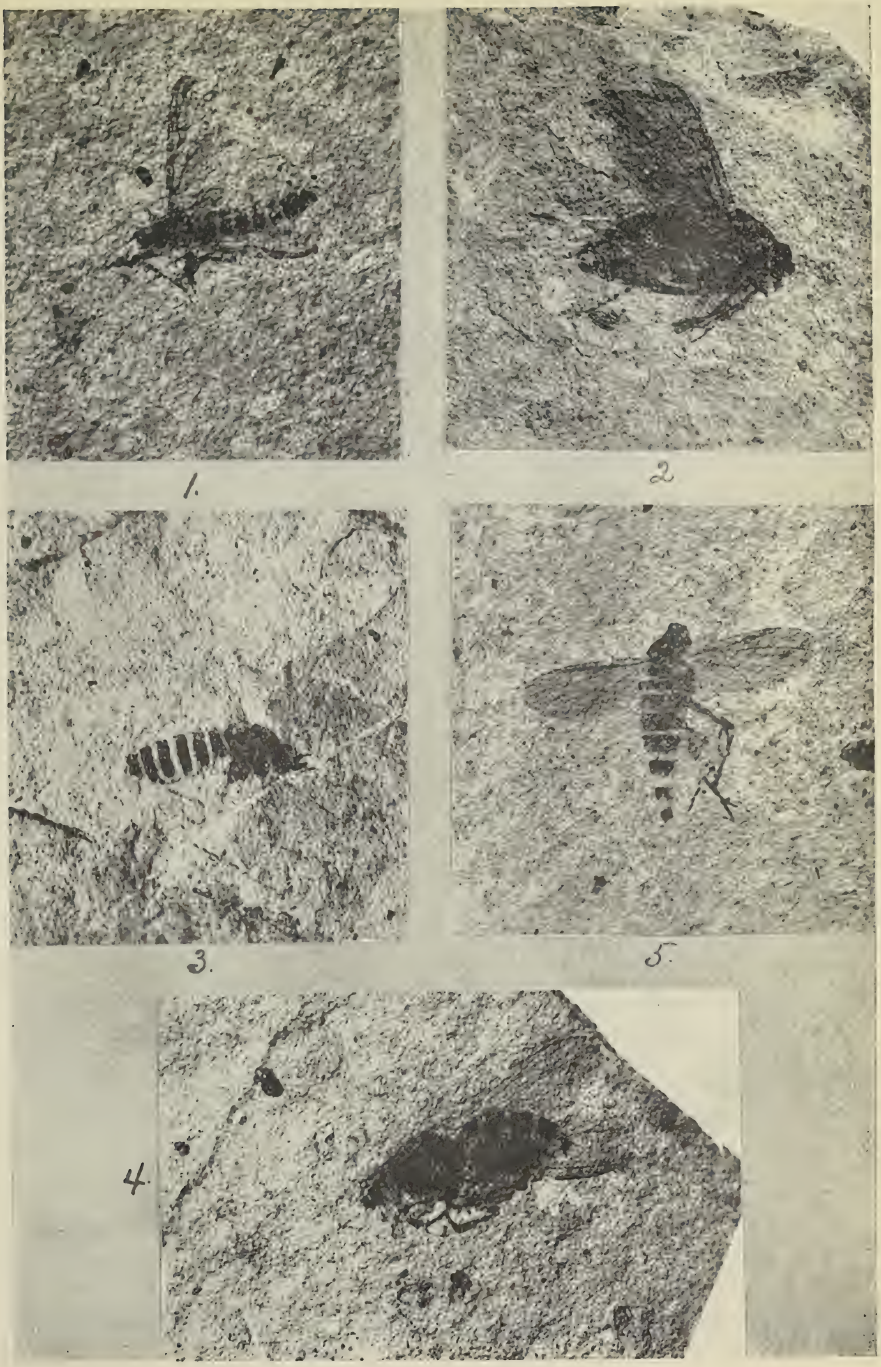
This also resembles *Heteropogon*, the most obvious difference being that the fourth posterior cell is not contracted apically.

Megacosmus secundus n. sp. (Bombyliidæ.)

Wing $12\frac{1}{3}$ mm. long, 4 broad, dilute fuliginous; thorax black, $3\frac{1}{2}$ mm. broad; face with some long hairs; proboscis slender, about 4 mm. long. Close to *M. mirandus*, but readily distinguished by the form of the second and third posterior cells; the second is very much widened apically, while (as a consequence) the third is contracted, being of the same width at apex (320 μ) as the anal cell.

The following measurements in microns also differ more or less from those of *M. mirandus*:

Distance between end of second vein and of anterior branch of third	1500
Anterior cross-vein from apex of discal cell	880
Anterior cross-vein from base of discal cell	4080
Third posterior on discal (not allowing for curve)	2720
Second posterior on discal	530



1. *Plecia melanderi* n. sp.
2. *Symphoromyia subtrita* n. sp.
3. *Melanderella glossalis* n. sp.
4. *Eucallimyia fortis* n. sp.
5. *Leptis mystaceæformis* Ckll. (See Vol. XXVI, 1909, p. 69.)

All figures three times natural size.

First posterior on margin	510
Width of anal cell opposite end of second basal	770
Second basal on discal	960

While the length of the discal cell is practically as in *M. mirandus,* the anterior cross-vein is nearer the end in *M. secundus.*

Miocene shales of Florissant, station 13 B. (Geo. N. Rohwer.)

In venation this genus resembles *Legnotomyia* Bezzi, found in Syria. The most noticeable difference is in the long discal cell of *Megacosmus.*

Lithocosmus coquilletti *Ckll.* (Bombyliidæ.)

A good specimen was found by Mr. S. A. Rohwer at station 14, Florissant. It is 8 mm. long, the wings $6\frac{1}{3}$ mm., thus rather smaller than the type.

Melanderella glossalis *Ckll.* (Bombyliidæ.)

Plate III, Fig. 3.

A specimen from Station 14, Florissant (S. A. Rohwer) lacks the ends of the wings, but is in some respects better preserved than the type. The præfurca is very short (130 μ); in the type it was described as absent, but it is really present, though only 64 μ long. The following measurements are from the new specimen, but those marked * have been compared with the type and found to agree: —

End of first vein (at a very acute angle on costa) basad of level of forking of third	210
First submarginal cell on first basal *	960
First submarginal cell on first posterior	1105
First basal cell on discal *	800
First posterior on discal	565
Second basal on discal *	145
Second basal on third posterior (the bounding nervure straight)	220
Discal on third posterior	800
Width of anal opposite end of second basal	195

The measurements here given are a little smaller than those of former papers, a new test of the micrometer scale showing that the estimated values were slightly too great.

The anal cell is closed just before the margin of the wing. The thorax is not much humped, and is without evident bristles; the legs are not

bristly, but are very minutely hairy. The hind margins of the abdominal segments have short black bristle-like hairs, the longest about 110 μ.

This must be near the common stem of the Toxophorinæ and Systropinæ.

Eucallimyia n. gen. (Platypezidæ.)

Rather large and robust flies, the general aspect, and marking of the abdomen, very suggestive of *Glossina* (especially *G. pallidipes* Austen); thorax and abdomen with fine dark bristles, those on hinder part of abdominal segments larger, the longest about 490 μ; legs rather robust, finely hairy all over; tarsi not deformed (but type is apparently a female); middle tibiæ with a fringe of stout black spines at apex; venation essentially as in *Callimyia*, but end of first vein (which is very conspicuously bristly) exactly midway between ends of auxiliary and second veins (the distance in the type species being in each case 2720 μ); vein bounding outer side of discal cell evanescent, but its position clearly indicated by a bend in fourth vein.

This insect has caused me some perplexity, but I believe it can only rest in the Platypezidæ, close to *Callimyia*, with which it agrees in the essential characters of the venation. Flies referred to *Callimyia* have already been described from the Eocene of Colorado and Wyoming, and it is probable that this type, now confined to a few species, was once much more abundant and varied.

Eucallimyia fortis n. sp.

Plate III, Fig. 4.

Length about 10 mm., reddish-brown, paler beneath, dorsal abdominal segments dark fuscous, with the sutures broadly pallid; wings $8\frac{1}{2}$ mm. long, ample, pale reddish hyaline; end of first vein, which carries a row of black bristles, about 5 mm. from base of wing and $3\frac{1}{2}$ from apex; auxiliary vein forming an acute angle with costa (as in Platypezidæ and Ortalididæ, not as in Trypetidæ); one submarginal and two posterior cells; first posterior gradually broadening to level of end of discal, thence slightly narrowing; width of discal cell at apex the same (880 μ) as width of first posterior at same level; anterior cross-vein far basad, not quite clearly visible, but apparently about 1085 μ from base, and 2480 μ from apex, of discal cell; middle tibia at apex with seven spines; this tibia is about 1920 μ long, and 400 wide at apex.

Miocene shales of Florissant (Geo. W. Rohwer).

Meunier notes the affinity between the Dolichopodidæ and Platypezidæ, suggesting that the former gave rise to the latter in the early Tertiary. Lameer, perhaps with the same idea, places Dolichopodidæ at the end of the Orthorrhapha, immediately followed by Platypezidæ at the beginning of the Cyclorrhapha. The venation of *Eucallimyia* is not very unlike that of various Dolichopodidid genera.

Article VII.—EOCENE AND OLIGOCENE OF THE WIND RIVER AND BIGHORN BASINS.

By W. J. Sinclair, Princeton University, and Walter Granger, American Museum of Natural History.

Plates IV–IX.

	Page
Introduction	84
Eocene and post-Eocene Basins of Accumulation	85
Oligocene and post-Oligocene Erosion	86
The Wind River Basin	86
The Bighorn Basin	87
The Eocene-Oligocene Section of Beaver Creek and the Beaver Divide	88
The Wind River	90
1. The Wind River Shales	91
2. The Wind River Sandstones	92
3. The Wind River Tuffs	93
The So-called Bridger	94
1. The Basal Arkose	95
2. Shales of the So-called Bridger	95
3. The White Lignitic Tuff	95
The Uinta	97
The Oligocene	99
1. The post-Uinta Erosion	99
2. Volcanic Mud Flows	99
3. Oligocene Gravels from pre-Tertiary Rocks	100
4. Wind-blown Sand and Dust	101
5. Limestone and Spring Deposits	102
The Lost Cabin Section of the Wind River	103
Deformation of the Wind River	105
The Eocene-Oligocene Section of the Bighorn Basin	105
The Floor of the Eocene Basin	105
The Bighorn Wasatch	106
Faunal Horizons	107
The Bighorn Wind River	108
Post-Wind River Lignitic Shales	109
Tatman Mountain Gravels	111
Diastrophic Movements involving the Eocene in the Wind River and Bighorn Basins	111
Life Conditions in the Wind River and Bighorn Basins during the Eocene and Oligocene	112
Origin and mode of Deposition of the Sediments	112
Source of the Color-banding	114
Occurrence of Organic Remains	117

INTRODUCTION.

The American Museum expedition of 1910 had, as its primary object, to study and collect from the Lower Eocene deposits of the Bighorn basin in northwestern Wyoming, but, at the beginning of the season, about a month was spent in reviewing the stratigraphy of the Wind River basin with special reference to the source of the sediments and their mode of deposition. A more careful study of the Beaver Divide section north of Hailey and east of Beaver Creek (Map, Fig. 1) than was possible last year has necessitated the publication of certain corrections and has brought out many new facts regarding the volcanic phenomena of the Eocene and Lower Oligocene. A short stop in the vicinity of Lost Cabin to reëxamine the Wind River formation fully confirmed the fact of the superposition of the Lambdotherium beds east of Lost Cabin on the so-called Cottonwood Draw exposures, without *Lambdotherium* or *Systemodon,* as described by Mr. Granger in a former publication,[1] and afforded sufficient data for a subdivision of the rocks of the Wind River series. Early in July, the party reached the Bighorn basin. From various camps between Basin and St. Joe Post-office the richly fossiliferous Wasatch exposures south of the Grey Bull River were studied and collections secured from levels ranging from near the base of this formation on Elk and Antelope Creeks to the top on Tatman Mountain. Sufficient palæontological evidence was accumulated to demonstrate conclusively the presence of the Lambdotherium zone of the Wind River above the true Wasatch on this butte. Collections were made from three more or less well-defined fossiliferous zones in the Wasatch, all below the level of Dr. Loomis's upper and lower Tatman Mountain horizons.[2] These two horizons it was not found possible to trace in the area north of Tatman Mountain examined by the American Museum party, nor were we able to identify here more than a few of the subdivisions given in Dr. Loomis's section,[3] a circumstance explainable by the lens-like nature of the Wasatch strata and the change in the lithology of the sediments from the margin toward the center of the basin.

As the party was unprovided with surveying instruments, no accurate sections could be prepared. Those presented herewith are diagrammatic only, the profile in every case having been sketched and the elevations measured by hand level. The faunal horizons indicated in Fig. 2, B are, likewise, only approximately placed.

---

[1] Tertiary Faunal Horizons in the Wind River Basin, Wyoming, with Descriptions of New Eocene Mammals. Bulletin American Museum of Natural History, Vol. XXVIII, Art. XXI, pp. 235–251, 1910.

[2] Origin of the Wasatch Deposits. American Journal of Science, 4th Series, Article XXXIV, Vol. XXIII, No. 137, 1907.

[3] *Ibid.*, Fig. 1, p. 359.

EOCENE AND POST-EOCENE BASINS OF ACCUMULATION.

The present Wind River-Bighorn drainage system is incised largely in Tertiary rocks constituting the filling of two great structural depressions of which the northerly or Bighorn basin, inclosed on the east and south by the Bighorn, Bridger and Owl Creek mountains and on the west by the Shoshone, Carter Mountains and other ranges still opens freely to the north, while the southerly or Wind River basin, rimmed about on the north and west by the Bridger, Owl Creek and Wind River ranges undoubtedly opened, originally, toward the east. The mountains are mainly anticlinal, involving formations ranging in age from pre-Cambrian to Fort Union, except in the Shoshone mountains where younger volcanic rocks occur. The basins or troughs which they inclose were filled during the Tertiary with detrital material deposited as river-borne muds, sands and gravels derived from the decay and erosion of older rocks, supplemented, locally, by volcanic tuffs and mud flows, wind-blown dust, limestone and spring deposits. In the Wind River basin sedimentation was continuous from the later Lower Eocene to the Lower Oligocene, with the exception of an interval of erosion at the close of the Upper Eocene. This was followed, in the Lower Oligocene, by volcanic outbursts of great violence. In the northerly basin accumulation began earlier in the Eocene with the deposition of the Wasatch and continued, probably, into the Oligocene, although this has not been fully established as the correlations presented on a later page are based on stratigraphic, lithologic and physiographic data and not on fossils. The difference in age of the earliest sediments in these adjacent basins was explained by Wortman,[1] adopting the now discredited lacustrine hypothesis, by the assumption that a lake existed in the Bighorn basin, while across the mountains to the south free drainage persisted, probably in an easterly direction. By the elevation of an eastern barrier of the Wind River basin, a later lake was formed in which the Wind River sediments were accumulated. This lake, on becoming filled, found an outlet to the north, excavating the gorge of the Wind River cañon. That this explanation is not in accord with recently ascertained facts will appear from the following section. The sedimentary record in both the Wind River and Bighorn basins closes wth the formation of a gravel-strewn plain, the dissection of which is still in progress.

---

[1] Geological and Geographical Sketch of the Bighorn Basin. In Article XI, Bulletin American Museum of Natural History, Vol. IV, p. 143, 1892.

OLIGOCENE AND POST-OLIGOCENE EROSION.

The Wind River Basin.— On the crest of the divide between the headwaters of Beaver, Muskrat, Conant and Deer Creeks, northward-flowing tributaries of Wind River, and the easterly discharging Sweetwater drainage system, soft, limestone-capped ash beds and extensive gravel deposits occur, locally underlain by thick flows of andesitic agglomerate and tuff. As determined by associated fossils, these rocks are Lower Oligocene in age. They rest on the eroded surface of the Upper Eocene Uinta which is conformable with beds of supposed Middle Eocene age and these, in turn, conformable with the Wind River which rests discordantly on the upturned edges of the Cretaceous (Fig. 2, A).[1] South of Wagon-bed Spring the Oligocene limestone has preserved from erosion remnants of the once extensive ash beds beneath it, forming the buttes and mesas seen on the sky-line in Plate IV, Fig, 2. In the flat tops of these buttes and mesas are preserved remnants of the floor of the Wind River basin at the close of its depositional history in the Lower Oligocene. The beginning of the excavation of the present drainage system is, therefore, later Oligocene or post-Oligocene in age. Although physiographic studies were not pursued in detail, the erosional history of the Wind River basin is seen to involve all of the following stages:[2]

1. The plain represented by the flat tops of the buttes and mesas already described (Plate IV, Fig. 2).

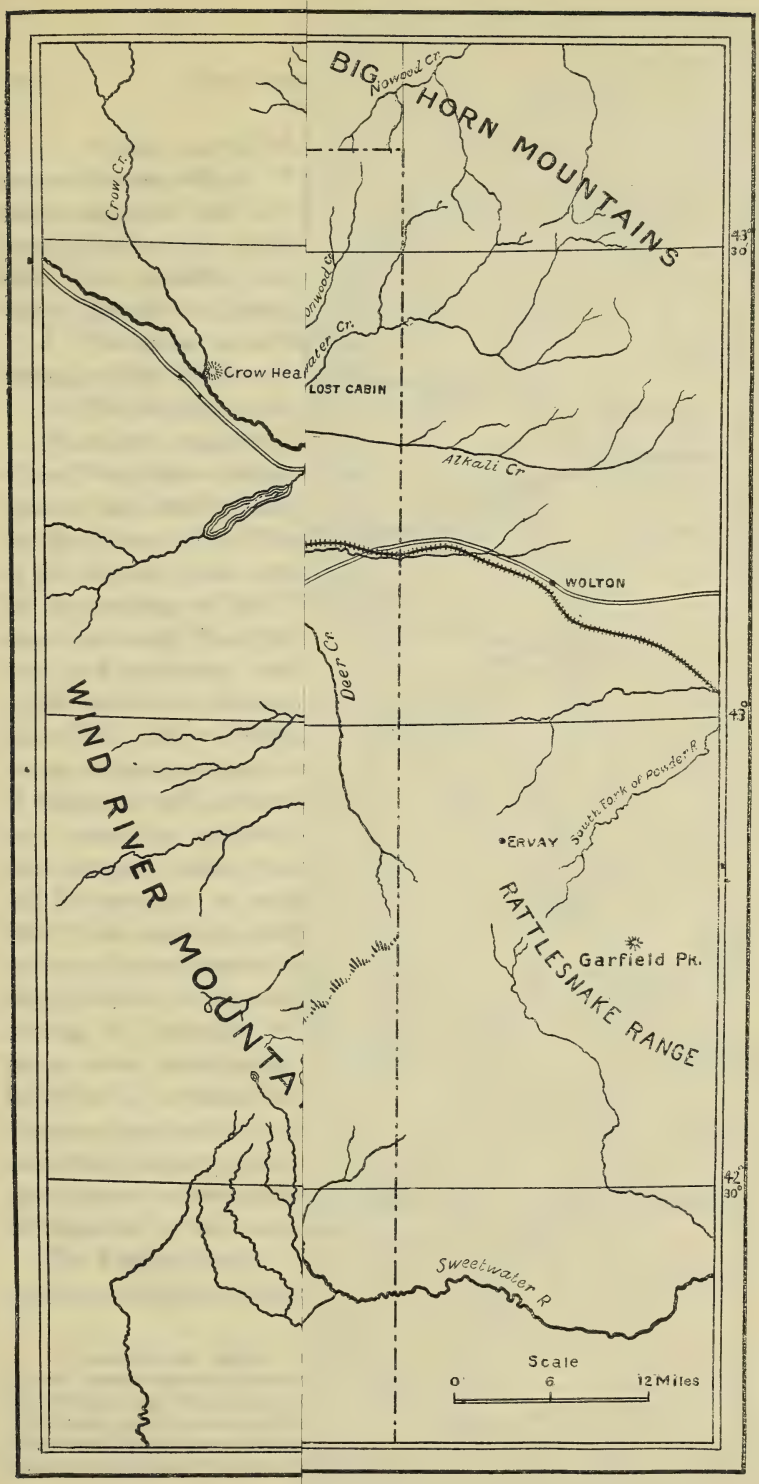
2. A baselevel of erosion, 525 feet more or less below the old basin floor, controlled by the top of the Oligocene agglomerate (Fig. 2, A) or, where the agglomerate is absent, by the top of the Uinta sandstone. This is the level sagebrush-covered plain seen in the foreground of Plate V, Fig. 2, and in the even sky-line at the left hand side of the picture in Plate IV, Fig. 2.

3. Traces of another baselevel are preserved in the bench or terrace, mantled with landslides (Fig. 2, A, and Plate IV, Fig. 2, middle distance) at or near the top of the soft shales of the so-called Bridger. Although the landslides have had much to do with the formation of this terrace they are not entirely responsible for it.

---

[1] Endlich's vaguely defined Sweetwater Group includes some of the formations mentioned above. Eleventh Annual Report of the United States Geological and Geographical Survey of the Territories, 1877, pp. 110–112.

[2] Stages 4, 5 and 6 below, agree in all essentials with the erosional history of the region south of Rock Springs, Wyoming, described by Rich. Physiography of the Bishop Mountain Conglomerate. Journal of Geology, Vol. XVIII, pp. 601–632, 1910. The great peneplain on which the Bishop conglomerate rests possibly corresponds to No. 1 of the series of stages mentioned in the text above.


BIG HORN MOUNTAINS
Norwood Cr.
Crow Cr.
Crow Hea
LOST CABIN
Alkali Cr.
WOLTON
Deer Cr.
WIND RIVER MOUNTA
South Fork of Powder R.
ERVAY
RATTLESNAKE RANGE
Garfield Pk.
Sweetwater R.
Scale
0
6
12 Miles
43° 30'
43°
42° 30'

ter Granger.)

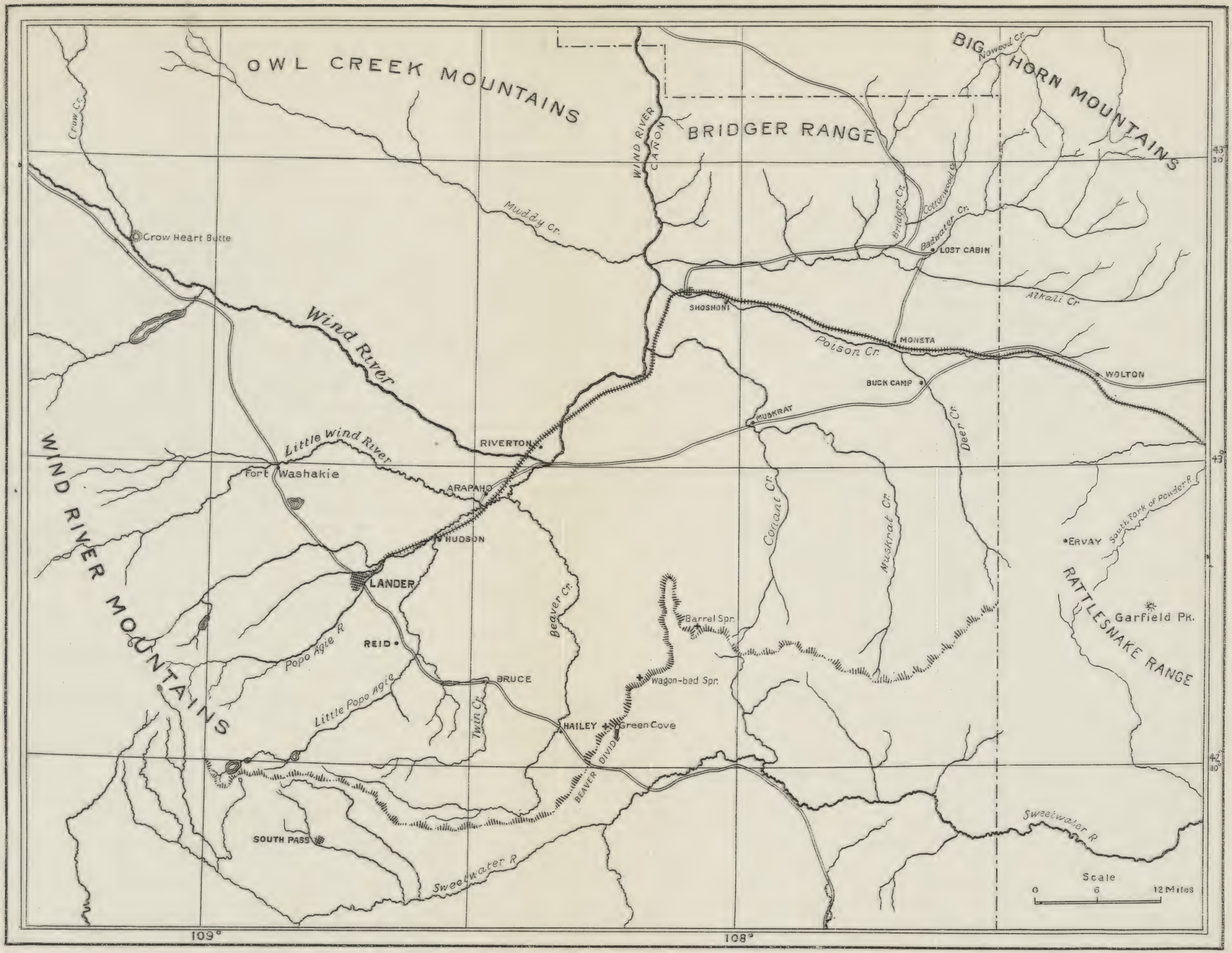
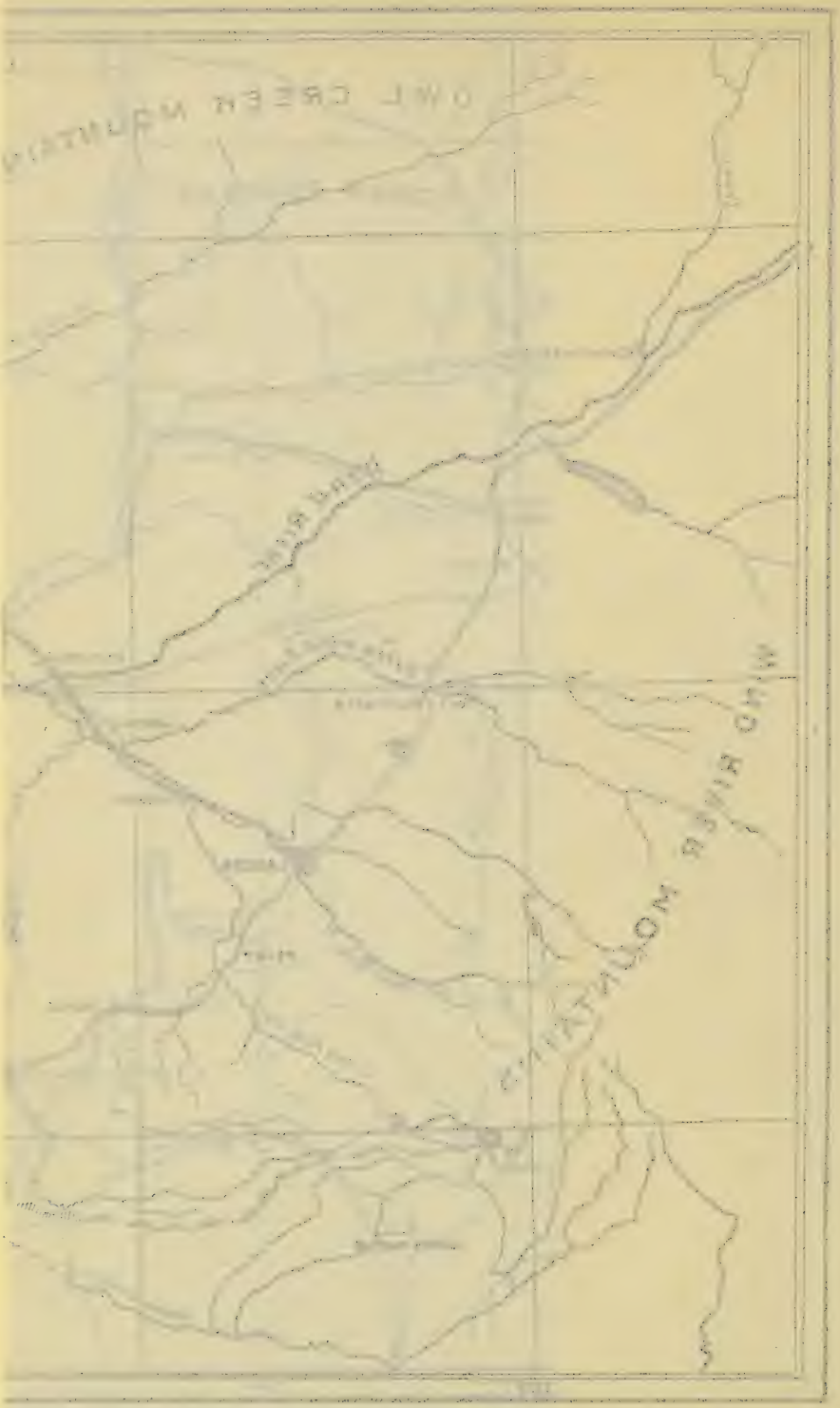


Fig. 1. Sketch map of the Wind River Basin. Based mainly on a map of Fremont County, by N. F. Brown. (After Granger.)



4. A long interval of erosion which resulted in the excavation of the present stream valleys. Probably several minor aggradational and degradational stages are here involved, as in all the modern stream valleys one or more gravel-strewn terraces occur above the level of the present valley floor. It is probable that some of these have been formed by the reëxcavation of deposits laid down in the valley troughs.

5. The silting up of the modern valleys, producing the broad flat floors through which the present streams have cut.

6. The cutting of the shallow trenches of the modern streams.

Wortman's suggestion, quoted above, regarding the easterly drainage of the Wind River trough during the Eocene is probably correct and, if we assume that erosion and transportation exceeded deposition, will account for the absence of the Wasatch (see page 85) which was then accumulating in the Bighorn basin across the mountains to the north. Such a direction for the drainage of the Wind River trough until after the lower Oligocene seems necessary from the position of the mountain barriers to the north, west and southwest, and from the extension of Oligocene sediments far to the east in the direction of Bates's Hole. Wortman's barrier (the Sweetwater-Wind River divide), which he supposed ponded the easterly flowing waters and so produced a lake, is not due to uplift, but to removal by erosion of Oligocene rocks accumulated in and beyond the same trough which had been receiving sediments since later Lower Eocene. More extensive physiographic studies than the writers have found opportunity to attempt will be necessary to explain the origin of the gorge through the Bridger-Owl Creek range by which the Wind River enters the Bighorn, but it does not seem beyond reason to suggest the possibility of the reversal and northward diversion of the early Oligocene Wind River drainage by the backward cutting of a tributary of the Bighorn at a time when the floors of both basins were considerably higher than they are to-day, previous to their reduction by erosion during later Tertiary and post-Tertiary time. The vigorous headwater cutting which has enabled Beaver, Muskrat, Conant and Deer Creeks to push back toward the Sweetwater and so maintain the steep north- and west-facing escarpment of the Beaver Divide [1] may possibly be traceable to this cause.

The Bighorn Basin.— That the Tertiary infilling of the Bighorn basin has been subjected to enormous erosion is at once apparent to an observer

---

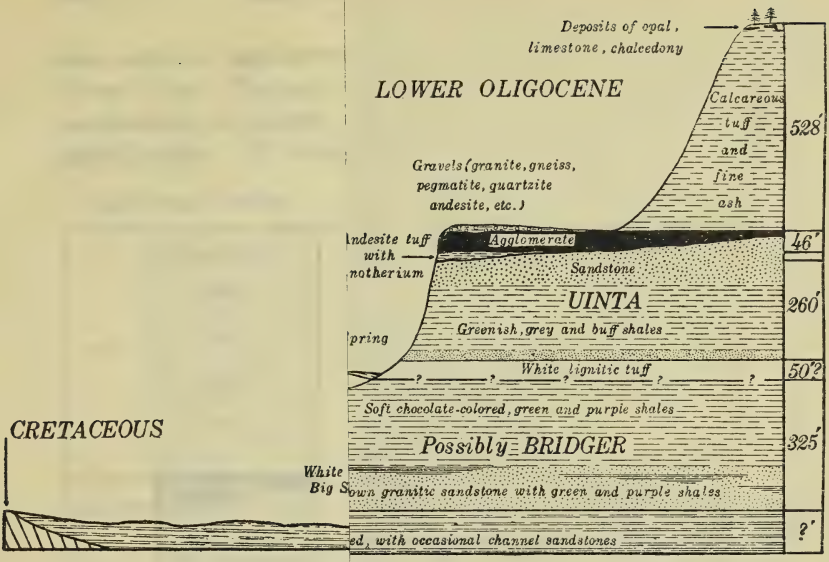
[1] A name locally applied to that part of the Sweetwater divide where it is crossed by the old Lander-Rawlins stage road. From the crest of the divide, there is a gentle slope southward to the Sweetwater, while to the north and west the descent is abrupt, in places precipitous, and is so maintained to the eastward along almost the whole southern border of the Wind River basin, due to the vigorous headwater erosion of certain northerly flowing streams, as explained in the text above.

standing on the flat-topped summit of Tatman Mountain and looking off over the great depression of Buffalo basin to the south or the valley of the Grey Bull to the north. Tatman Mountain, in reality only a residual butte spared by erosion, is capped by stream-worn andesitic gravels which may be of Oligocene age, as will be suggested later. The gravel sheet is underlain by about 600 feet of sandstone and lignitic shales in which no fossils have yet been found except leaf impressions, fresh-water molluscs and entomostraca. These rest conformably on the Wind River (Lambdotherium zone) and this, in turn, is in direct stratigraphic continuity with the Wasatch. As shown by remanic gravels at lower levels, derived from the deposit on Tatman Mountain, erosion has spared but a small part of this once extensive formation. As no fossils have yet been found in the gravels, their age is uncertain, but on the strength of certain lithologic similarities to be referred to later, they may be regarded as Oligocene and the dissection of the Tertiary deposits of the Bighorn basin fixed as later Oligocene and post-Oligocene. The flat top of Tatman butte is, therefore, correlated with Stage 1 (page 86) of the Wind River basin erosion cycle. Stage 2 of the latter finds its equivalent, apparently, in the well-marked bench or terrace some 525 to 550 feet, more or less, below the top of Tatman Mountain (see diagram, Fig. 2, B). Stage 3 has not been satisfactorily identified, but from the initiation of the great erosion, Stage 4, there is close equivalency in the two basins.

THE EOCENE–OLIGOCENE SECTION OF BEAVER CREEK AND THE BEAVER DIVIDE.

From the Cretaceous [1] at Hudson to the top of the divide at Wagon-bed Spring a complete section of the Tertiary deposits of the Wind River basin may be studied from almost continuous exposures, especially on the east side of the valley of Beaver Creek, as shown in diagrammatic section (Fig. 2, A). Granger's figure,[2] showing a generalized section of the Tertiary of the Beaver Divide, differing in several respects from that published herewith, was based primarily on the succession of beds at Green Cove about four miles south of Wagon-bed Spring (map, Fig. 1), where several of the formations indicated in Fig. 2 A are absent and where considerable difference in the thickness of the remaining elements appears, probably due to thinning out toward the margin of the basin of accumulation. As shown in the diagram (Fig. 3) neither the white lignitic tuff nor the Oligo-

[1] Montana in age. Communicated by Mr. E. G. Woodruff through Dr. F. H. Knowlton.
[2] *Loc. cit.*, p. 238, fig. 1.



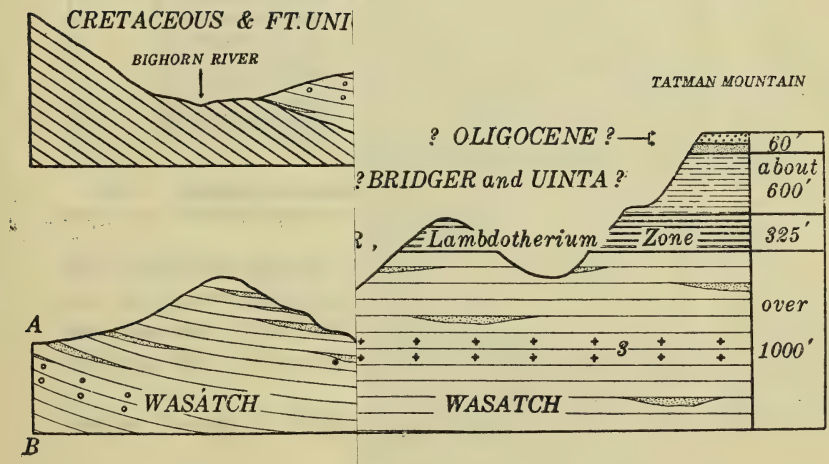
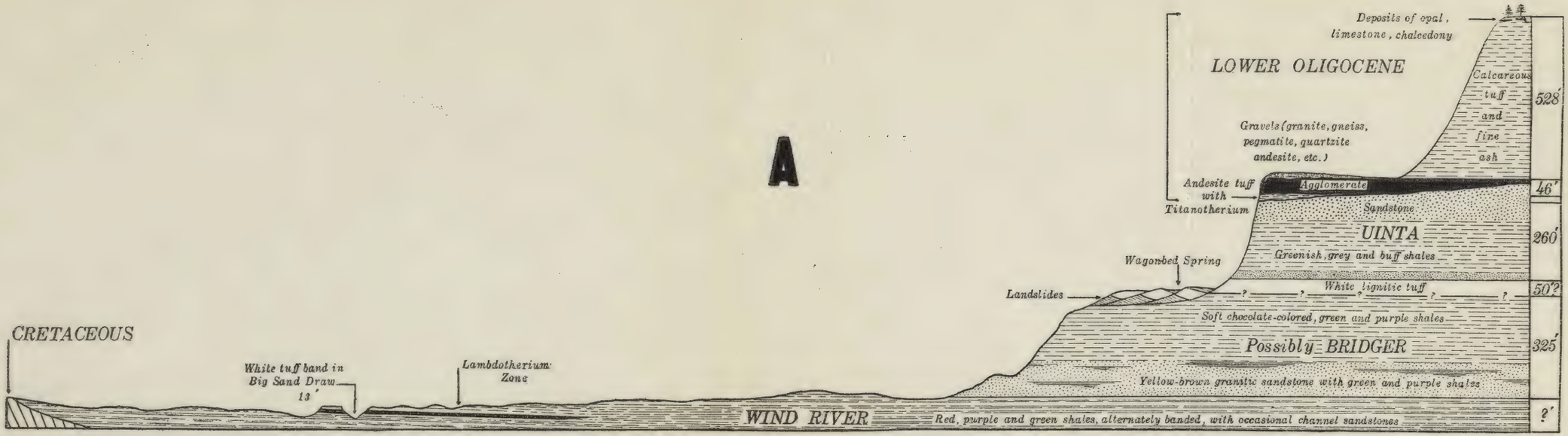


Fig. 2A. Diagrammatic sectio Horizontally, not to scale; vertically, 500′ = 1″. Section from top of Wind River to

Fig. 2B. Diagrammatic sectio mouth of Elk Creek. Not to scale either horizontally or vertically.



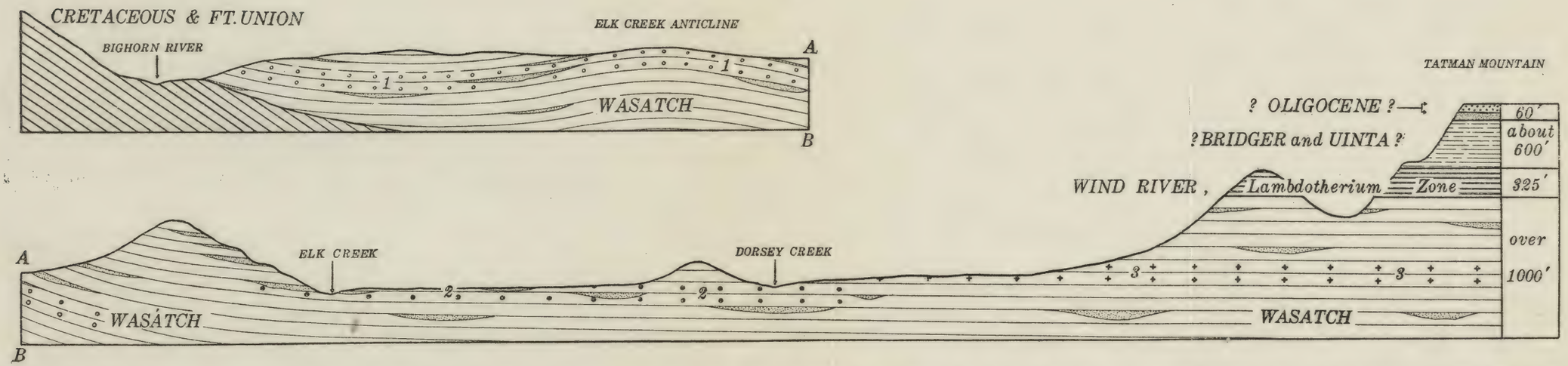


Fig. 2A. Diagrammatic section across the Wind River basin from the Cretaceous at Hudson to the top of the Beaver Divide at Wagon-bed Spring. Horizontally, not to scale; vertically, 500′ = 1″. Section from top of Wind River to top of lignitic tuff measured ½ mile north of Wagon-bed Spring; from top of tuff to top of Oligocene, ½ mile south of spring.

Fig. 2B. Diagrammatic section across the Bighorn Basin from the top of Tatman Mountain easterly to the Cretaceous and Fort Union opposite the mouth of Elk Creek. Not to scale either horizontally or vertically.

cene andesitic agglomerate studied at Wagon-bed Spring are present at Green Cove. The ash bed indicated in Granger's generalized section was inserted to conform with the stratigraphic succession at the first mentioned locality. So far as at present ascertained, the correlations between

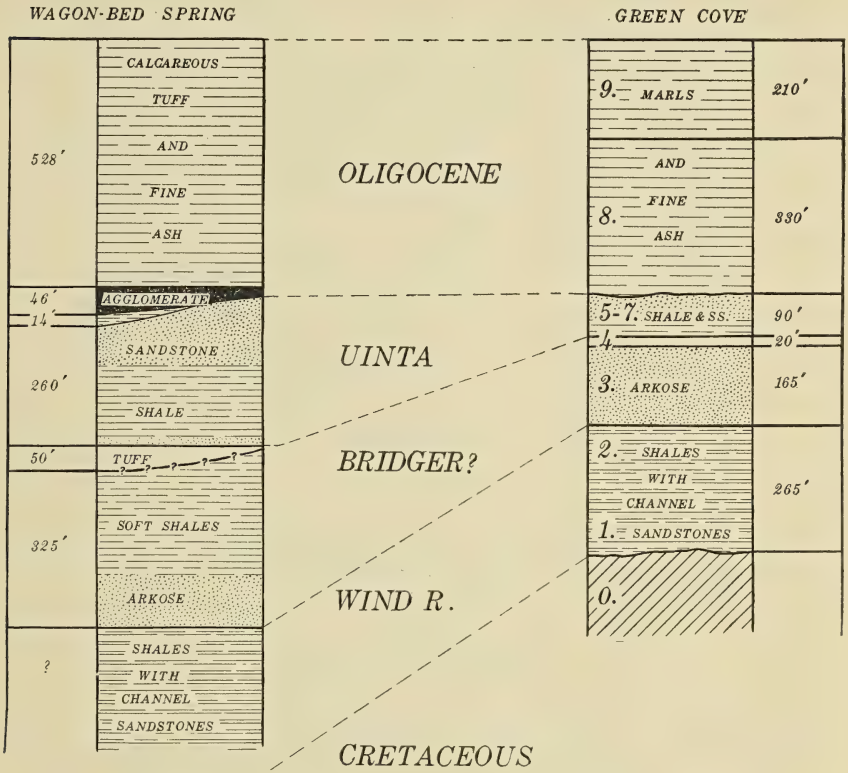


Fig. 3. Diagram showing the relations of the Wagon-bed Spring and Green Cove sections of the Tertiary deposits of the Beaver Divide.

the Wagon-bed Spring and Green Cove sections are indicated in Figure 3, and for convenience in comparison a detailed statement of the latter is here inserted. The beds to which the numbers refer are indicated in the diagram (Fig. 3) and in the photograph (Plate VI).

Section through the Tertiary deposits of the Beaver Divide, about four miles east of Hailey.[1]

Top of Divide.

9. Buff and gray calcareous marls with some coarse sandstone and a little sandy shale. Marls more highly calcareous than No. 8, and toward the top weather out into hard ledges 210

[1] Granger, *loc. cit.*, pp. 237, 239.

8.	Buff-colored calcareous marls, very uniform in nature except the lower 50 feet where the marls are interbedded with coarse sandy layers from one inch to two feet in thickness	330
Erosion Unconformity.		
7.	Coarse greenish sandstone	10
6.	Yellowish-green and olive coarse, loosely compacted sandy stones	55
5.	Gray and yellowish clay	27
4.	Blue-gray clay and sandstone, forming a prominent ledge along the face of the bluff; weathers nearly vertical	20
3.	Beginning at the base of the main bluff where there is a red stratum corresponding with the one at the top of the butte in No. 2, the rock is pale yellowish brown and alternates between sandy and clayey shales, with coarse sandy beds at intervals. Some layers weather out harder, forming rounded ledges	165
2.	A small outlying butte is composed of alternating layers of gray and purplish clays, gray-green sandy shales and strata of coarse sand. Some of the sandy layers weather out salmon-colored . . .	125
1.	One mile out from the foot of the bluff, and resting nearly horizontally on upturned Cretaceous, are sandy clays, becoming more sandy toward the top, and with a two-foot stratum of calcareous sandstone midway. The clays are yellowish, greenish and purplish . .	140
	Total,	1082

O. Cretaceous.

The elements of the Beaver Creek-Wagon-bed Spring section may now be redescribed separately, in detail.

The Wind River.

The extensive badland area between the outcrop of the Cretaceous at Hudson and the base of the Beaver Divide escarpment is carved from a series of red, reddish-purple, and bluish-green shales (the red and bluish-green colors alternating), unconsolidated arkosic sands with many water-worn pebbles of quartz and feldspar, and one prominent, though local, band of white tuff. These rest uncomformably on the Cretaceous and dip beneath the Beaver Divide escarpment at a low angle (about 1° 15′). From the few fossils (*Eohippus* sp., *Phenacodus* sp., *Coryphodon ? testis*) obtained during the summer of 1909, these beds were referred doubtfully by Granger to the Wasatch.[1] During the past summer, a typical Wind River fauna was found by Mr. George Olsen of the American Museum party in a small amphitheatre of low badlands to the east of the valley of Beaver Creek, some four or five miles above its intersection with Big Sand Draw (Plate

[1] *Loc. cit.*, pp. 239, 240.

VII, Fig. 1). The entire fauna was obtained at or near the contact of a stratum of bluish-green shale resting on a red shale band, the fossiliferous zone not exceeding ten feet in thickness. The following association of forms was obtained:

Glyptosaurus (scutes).
Gar pike (scutes).
Crocodile (scutes, vertebræ and teeth).
Turtles (numerous fragments).
Hyopsodus sp. nov.
Hyopsodus sp.
Didymictis ? altidens.
Microsyops sp.
Eohippus craspedotus.
Eohippus ? venticolus.
Heptodon calciculus.
Heptodon ventorum.
Heptodon sp. nov.
Lambdotherium popoagicum.
Coryphodon sp.

The presence of fish and crocodiles in this fauna indicates plainly the fluviatile nature of the deposit in which they occur and goes far toward establishing a theory of flood plain origin for the Wind River shales, which is further supported by the presence of frequent channel fillings of coarse arkosic sandstone. Such a channel, a few feet above the horizon affording the fauna of the Lambdotherium zone, is shown in Plate VII, Fig. 2. It is filled with a coarse arkose containing water-worn, more or less kaolinized feldspar fragments, quartz and chlorite grains, foils of biotite and a small amount of clayey material associated with rounded grains and small pebbles of such pre-Tertiary rocks as quartzite, granite and gneiss, the whole slightly cemented with calcium carbonate. All the fossils from the shales are fragmentary and consist mostly of teeth with the roots worn off and only the crowns remaining, an indication that they have been transported in contact with abrasives.

Whether the entire thickness of banded beds between the horizon of the Lambdotherium fauna listed above and the outcrop of the Cretaceous at Hudson is to be regarded as Wind River cannot be positively stated and may be open to question in view of the discovery, in the Bighorn Basin, of the conformable superposition of the Wind River on the Wasatch without any lithologic dissimilarity between them.

1. *The Wind River Shales.*— These might with equal propriety be termed clays as they readily absorb water, swell and become more or less plastic. They occur in lenticular bands of variable extent and thickness and always highly colored, red or purplish red, mottled red and blue-green,

or blue-green, alternating with more or less regularity. Locally, an abundance of calcareous concretions of ball or star shape and radiate internal structure may be present, especially in the red clays, which may also be veined with the same material deposited along slipping planes and joint cracks. Anastomosing green lines traverse the red clays and spread along the joints where the color has been changed, perhaps by surface waters or organic acids from plant roots. Precisely similar green zones about undecayed roots were noted in a chocolate-colored Pleistocene or Recent clay exposed in an undercut bank on Beaver Creek. Under natural weathering, the clays break down into powder which becomes a sticky mud and flows down the badland slopes during every heavy rain. When dry, this is caked at the surface and extensively mud-cracked (Plate V, Fig. 1).

Of two samples examined in detail, the mottled red and blue-green variety possesses greater plasticity and finer grain while the red variety is less plastic and more gritty, due to the presence of small mineral particles, usually quartz and feldspar. Little can be determined microscopically regarding the origin of the clay. In addition to kaolin, an occasional minute feldspar fragment may be seen in the blue plastic clay. In the red and more gritty sample, larger grains of quartz and feldspar, some of them rounded, and an occasional round grain of chloritic material were observed.

A discussion of the origin of the color-banding in the clays may be deferred advantageously to a later page where it will be considered in attempting to explain a similar phenomenon in the Wasatch.

2. *The Wind River Sandstones.*— The Wind River sandstones in the vicinity of the Beaver Divide are stream channel deposits of predominantly arkosic character. A very perfect example has already been referred to and is figured in Plate VII, Fig. 2. It is a broad shallow trench cut in banded clays, traceable for a half mile or more, and filled with a barely coherent mass of coarse sandstone or even fine conglomerate composed of more or less water-worn grains or small pebbles of quartzite, granite and gneiss, quartz and feldspar, biotite foils and chlorite grains. Not all the sandstone beds are in such perfectly formed channels, but they are all more or less lenticular in cross section and may show slight erosional disconformity with the clays on which they rest although perfectly conformable above with the next succeeding stratum. In one instance small stems of petrified wood were noted, standing erect in the clay and abruptly truncated by the overlying sandstone. The sandstone here referred to lay directly beneath the white tuff described in the next section and contained scattered water-worn pebbles of a similar tuff in a matrix of small sharply angular fragments of feldspar, both orthoclase and plagioclase, often fresh but sometimes slightly kaolinized, quartz grains, biotite and muscovite foils, hornblende

needles, splinters of pink garnet, small, dark, opaque grains, probably iron ore and masses of kaolin, probably kaolinized feldspars, the whole cemented by calcium carbonate.

From these two average and quite typical examples, it would seem that the Wind River sandstones, in the region with which we are now concerned, represent deposits laid down in the channels of broad, shifting, low-grade streams flowing across clay-covered flats into which the channels were sunk or over which, in times of flood, the coarse detritus was spread. From the nature of the sediments composing these channel sandstones it is quite evident that they were derived from the decay of the granites and other pre-Tertiary rocks of the surrounding mountains. Absence of torrential streams is inferred from the fact that coarse conglomerates do not occur, although present in later formations in the same area.

3. *The Wind River Tuffs.*— Near the mouth of Big Sand Draw, referred to above in describing the position of the horizon affording the fauna of the Lambdotherium zone discovered by Olsen, and on the east side of the draw, a white tuff band, 13 feet thick, is interstratified with the Wind River clays and sandstones at a horizon considerably lower than that affording the fossils. It rests on a heavy brown sandstone containing rolled pebbles of tuff and is overlain by pale greenish shales. The upper four or five feet of tuff is highly pumiceous, containing grains of snow-white pumice varying in size from bird shot to small peas inclosed in a fine-grained gray matrix. The most abundant mineral constituent recognizable macroscopically is biotite, present in small cleavage foils inclosed in the white pumice grains, but not excluded from the matrix also. Occasionally a small fragment of feldspar may be found. In thin section both pumice grains and matrix are seen to be composed of a felt-like mass of wisps, needles and fine grains of isotropic glass inclosing in order of relative abundance: (1) orthoclase, often zoned, sometimes twinned on the Carlsbad law, either with recognizable crystallographic boundaries, more or less broken or in small laths, frequently with included apatite; (2) plagioclase (average extinction of pairs of twin lamellæ varying between 15° and 18°); (3) foils of olive-green, pleochroic biotite, sometimes with hexagonal outline; (4) splinters of pale green hornblende; (5) black opaque grains, probably iron oxide. A flow structure is sometimes developed in the pumice grains.

An analysis of this tuff kindly prepared for us by Professor A. H. Phillips in the chemical laboratory of the Department of Geology of Princeton University shows a remarkably high water content, much of which must be secondary. Recalculation on a water-free basis gives a percentage composition approximating that of certain rhyolites. This is further supported by the acid character of the plagioclase, judging from the average values of the extinction angles.

Pumiceous rhyolite tuff, Big Sand Draw, about twelve miles above the mouth of Beaver Creek, Fremont County, Wyoming. A. H. Phillips, analyst, December, 1910.

	%
SiO_2	65.62
Al_2O_3	13.07
Fe_2O_3	1.89
MgO	.95
CaO	2.59
Na_2O	3.39
K_2O	1.13
*H_2O below 110°	2.71
*H_2O above 110°	7.39
CO_2	0.00
TiO_2	.18
P_2O_5	.32
SO_3	.61
MnO	.016
	99.866

* No sharp distinction exists between water below and that above 110° in this analysis, as its emission was a continuous process.

The eight or nine feet of finer grained tuff beneath the pumiceous band just described is composed of a felt-like mass of glass granules and pumice wisps with flow structure inclosing many highly angular fragments of feldspar (both orthoclase and plagioclase), some quartz, olive-green biotite foils and splinters of green hornblende in greater abundance than in the pumiceous zone above, and many scattered black grains, probably magnetite. A few small apatite crystals were observed in the tuffaceous matrix, probably included originally in the biotite or feldspars. Many of the pumice grains have been infiltrated with secondary calcite, the presence of which is confirmed by treatment with dilute hydrochloric acid. Balls of hard green shale were observed in this tuff in the field. It is also traversed by channel fillings of contemporaneous origin, both indicative of fluviatile deposition.

The So-called Bridger.

About 375 feet of sandstone, shale and tuff lying between the red-banded clays of the Wind River and the Uinta shales have been referred doubtfully by Granger [1] to the Bridger. Although repeatedly examined during two seasons, no fossils have been found in these beds, the age determination

[1] *Loc. cit.*, pp. 238, 239.

depending entirely on stratigraphic relationships. So far as has been determined, this so-called Bridger is conformable with the underlying Wind River. There may be an erosional disconformity with the Uinta, as the white lignitic tuff band and the soft clay shales beneath it, observed at Wagon-bed Spring (Fig. 3), are absent four miles farther south at Green Cove, their place being taken by a twenty foot layer of a peculiar sandstone and clay mixture (No. 4, Green Cove section, Fig. 3 and Plate VI).

1. *The Basal Arkose.*— The first formation overlying the Wind River clays at the base of the Beaver Divide escarpment (Figs. 2 A and 3; Plate VI, No. 3) is an unconsolidated or slightly consolidated pale yellow-colored arkose containing an abundance of water-worn gravels occurring both scattered through the finer matrix and in more or less well-defined lenses. Pegmatite pebbles two or three inches in diameter or even more abound in these gravels. Quartz, feldspar, black chert and sandstone are also represented. The matrix is composed of subangular quartz and feldspar grains, with a few foils of biotite, rather numerous particles of chlorite and a little kaolinized material. The harder layers, which always weather out in relief, show minor disconformities with the softer beds on which they rest (Plate VI, No. 3). From the lenticular character of these harder beds, the local disconformities and the abundance of stream gravels throughout the mass it seems evident that we are dealing with the coarser detritus of a series of confluent alluvial fans deposited by streams draining from some granitic area near by, probably the Sweetwater Mountains. Occasional interstratified layers of shale represent, undoubtedly, the fine clays washed out of the arkose by the streams in which the latter was transported.

2. *Shales of the So-called Bridger.*— In the Wagon-bed Spring section, the gravels and arkose pass upward into olive-green sandy shales with some coarser sand layers. Above these are exceedingly soft, chocolate-colored, greenish and purplish-tinted shales or clays which readily absorb water and slip, producing the numerous landslides found everywhere throughout the middle portion of the Beaver Divide escarpment (Fig. 2 A, and Plate IV, Fig. 2).

3. *The White Lignitic Tuff.*— Owing to these landslides, the contact between the variegated shales or clays and a bed of white lignitic tuff which overlies them has been either concealed or so dislocated at every exposure discovered that we have not been able to ascertain whether it rests conformably on the clays or not. From its absence in the Green Cove section, and also to the northeast about the headwaters of Muskrat Creek, the tuff bed is evidently lens-shaped. Exposures were examined for a mile and a half or more north of Wagon-bed Spring which issues from the tuff in a land-slipped block, and for about a half mile to the south of the spring,

beyond which the tuff is concealed by talus and probably thins out and disappears. Various measurements of the thickness gave values ranging from 25 feet to 75 feet which have been averaged in constructing the section (Fig. 2 A). The tuff is a white, thin-bedded harsh-feeling rock varying in degree of cementation from pulverulent to compact, and contains frequent lignite beds varying in thickness from six inches to a foot. It shows no admixture of fluviatile material such as clay, sand or gravel and is possibly a lacustrine deposit. On chemical analysis, a sample of the pulverulent variety shows the following composition:

Tuff, half mile south of Wagon-bed Spring, Beaver Divide escarpment, Fremont County, Wyoming. A. H. Phillips, analyst, December, 1910.

	%
SiO_2	83.12
Al_2O_3	7.16
Fe_2O_3	.63
MgO	.09
CaO	.39
Na_2O	.25
K_2O	5.64
H_2O below 110°	.51
H_2O above 110°	1.52
CO_2	0.00
TiO_2	.15
P_2O_5	.05
SO_3	.37
MnO	.01
	99.89

As the silica percentage in this analysis is rather above the average for even the most acid tuffs, the presence of diatoms was suspected, but repeated microscopic examinations have failed to reveal more than one and the possibility of its accidental introduction was not fully guarded against. Perhaps the tuff has been secondarily enriched in silica, deposited in colloidal form by springs, but the only occurrence of opaline silica in the vicinity is at a much higher horizon in the Oligocene.

Under the microscope, the pulverulent tuff, of which the chemical composition has just been given, is seen to be made up almost entirely of exceedingly fine isotropic granules which appear structureless even under a 370 diameter magnification. A few splinters of clear feldspar may also be observed which the analysis shows to be orthoclase. The more compact variety, when examined with a hand lens, is found to contain many foils of olive-green biotite scattered through the white matrix. In thin section

hosts of minute feldspar fragments are seen, water-clear and highly angular. The feldspars are both untwinned and twinned (extinctions of pairs of twin lamellæ ranging from 15° to 26°). Foils of olive-green biotite are also present and, occasionally, light green hornblende in splinters and needles. Rusty opaque grains, probably iron oxide, and an occasional pumice fragment complete the list.

As mentioned above, the white tuff and underlying soft shales are absent at Green Cove, their place being taken by a twenty-foot blue-gray stratum of arkose, clay pellets and clay (No. 4, Fig. 3 and Plate VI). This is harder than the beds below it, from which it is separated by a slight disconformity, and weathers out in relief as a prominent cliff and terrace. Its superior hardness is not due to a calcareous cement (present in small amount), but seems rather to have resulted from a setting process. Under a low power, the hand specimen is seen to be traversed by numerous irregular tubules ($\frac{1}{2}$ mm. to 1 mm. in diameter), perhaps root-canals, lined with a white waxy clay. Small interstratified clay lenses and numerous clay pellets form a considerable part of this hard stratum. The remaining material is coarse arkose mixed with fine clay and minute isotropic grains (glass particles?). This stratum may, therefore, owe its superior hardness to the presence of ash which was deposited, apparently, under lacustrine conditions at Wagon-bed Spring, but elsewhere must have been more or less widely distributed by the wind and mixed with such terrestrial formations as were in process of accumulation. The clay-lined root-tubules, if such they be, may indicate a certain amount of leaching by surface waters either during or after the consolidation of this stratum. Possibly the clay lining may have been formed by organic acids from the roots themselves.

The Uinta.

In the field, the plane of demarcation between the so-called Bridger and the Uinta was arbitrarily placed at the top of the white lignitic tuff in the Wagon-bed Spring section, as no structural break could be detected between it and the overlying shales with *Amynodon* and other Uinta fossils.

Wherever exposed, the lignitic tuff is conformably overlain by a rust-colored, fine-grained silt, frequently concretionary, owing its color to the yellow staining of multitudes of cottony grains, doubly refracting, silvery white in color, between crossed nicols and evidently representing kaolinized or sericitized material. Much finely divided feldspar, both orthoclase and plagioclase, small fragments of biotite and hornblende and considerable magnetite are also present. If quartz occurs, it could not be distinguished from the small water-clear feldspars.

The formation just described is overlain conformably by the so-called "joint-clays"[1] of the Uinta with *Amynodon,* etc., light cream-colored to pale greenish shales with the same association of minerals as in the yellow silts below, but with the kaolinized material of finer grain. As the specimen examined showed no tendency to become plastic when soaked in water, even after the large amount of calcium carbonate present had been removed by treatment with acid, the term "clay" is hardly applicable. The shales are irregularly jointed (Plate VIII, Fig. 1, lower margin of picture), readily crumbling, when exposed to the weather, into small fragments forming the steep talus slope below the escarpment of the Uinta sandstone (Plate VI, Figs. 1 and 2).

The sandstone (Plate IV, Fig. 2) is a medium-grained, greenish-colored rock which, in addition to vast numbers of kaolinized fragments ranging in size from fine dust to particles a third of a millimeter in diameter or thereabouts, white, rusty red or purplish pink in color (probably kaolinized feldspar though some few suggest pumice in texture), contains abundant angular fragments of orthoclase, water clear or slightly cloudy, an occasional plagioclase (average extinction on twin lamellæ varying from 15° to 26°), quartz grains, hornblende splinters, biotite foils and abundant magnetite sand. The association of glassy feldspars with weathered and kaolinized grains suggests their derivation from granitic rocks by temperature changes causing shattering of the unweathered minerals. That the sandstone is of granitic origin seems beyond question, for, locally, it becomes a coarse arkose with siliceous cement. Great blocks of this, fallen from the cliff controlled by the Unita sandstone and Oligocene agglomerate strew the land-slipped area south of Wagon-bed Spring (Plate IV, Fig. 2). In the silicified arkose, large angular fragments of orthoclase, microcline and plagioclase (extinctions on albite twin lamellæ ranging from 17° to 21°) both absolutely water clear and also dull white, abundant and large grains of quartz and a few splinters of green hornblende are firmly cemented together by a siliceous paste, both opaline and chalcedonic. The resulting rock is so hard that it readily breaks across the quartz grains when a hand specimen is trimmed. The opaline silica of the paste is gray-white in color in transmitted light and absolutely isotropic between crossed nicols. Until the nicols are crossed, the chalcedonic silica cannot be distinguished from the clear quartz grains, but between crossed nicols it appears as a spherulitic aggregate, some of the spherulites showing the central black cross distinctly. No calcite is present as a cementing substance.

At Green Cove, the medium-grained green sandstone of the Uinta, con-

---

[1] *Loc. cit.*, p. 238, Fig. 1.

taining many quartz and feldspar pebbles (Plate VI, No. 7) can be readily identified. Uinta Number 6 of this section is very much like the arkose of the so-called Bridger (No. 3) and like it contains abundant quartz and feldspar pebbles, while Number 5 shows, in superficial appearance at least, some resemblance to the cream-colored shales of the Uinta already described. In the section at the head of Muskrat Creek a fine-grained, bluish-gray shale occupies the position of the Uinta below the Oligocene gravels which here rest upon it.

As shown in the diagram (Fig. 3) the total thickness of the Uinta varies much as does that of the individual elements which, also, change in character from place to place.

The Oligocene.[1]

1. *The post-Uinta Erosion.*— After the close of Eocene deposition, broad shallow valleys, indicative of a fairly mature topography, were excavated in the Uinta sediments (Plate IV, Fig. 1). Ripple marks and mud-pellet conglomerate observed at the bottom of the channel, of which a part is seen in Plate IV, Fig. 1, show that the valleys were, at times, occupied by running water.

2. *Volcanic Mud Flows.*— Shortly after the cutting of the valleys, explosive volcanic eruptions broke out somewhere in the vicinity, and the first deposit laid down in these troughs was a fine-grained, buff-colored tuffaceous shale (Plate IV, Fig. 1, O1). It was in this tuff that the American Museum party of 1909 found a skull of *Titanotherium heloceras* which, with other vertebrate fossils[2] from higher levels, determines the age of all the beds above the post-Uinta erosion cycle as Lower Oligocene.

Vulcanism soon became extremely violent, ejecting great blocks of hornblende andesite which, with ash, pumice, lapilli, and pebbles and cobbles of pre-Tertiary rocks, were swept down the valleys as mud-flows. The vents from which this material came have not yet been located. They continued in eruption during the whole of the Lower Oligocene, as here represented, showering the surrounding region with dust. The agglomerate resulting from these mud-flows attained a thickness of 46 feet in the vicinity of Wagon-bed Spring. As its distribution was controlled by the then-existing valleys, it can readily be understood why it is not present at Green Cove. The Wagon-bed Spring flow thins out toward the south and, for some distance north of the lone butte seen on the sky-line in Plate IV,

---

[1] Possibly the same beds which are referred to vaguely by Endlich, *loc. cit.*, pp. 112, 113, as Pliocene.

[2] Granger, *loc. cit.*, faunal list, p. 240.

Fig. 2, the Uinta sandstone is at the level of the top of the agglomerate. A second flow is seen in the face of the escarpment below the distant mesa at the extreme right of the picture but thins out also before reaching Green Cove. The agglomerate may rest on the buff-colored tuffaceous shale already mentioned or on the Uinta sandstone (Plate IV, Fig. 1; Plate VIII, Fig. 1), often with a basal conglomerate inclosing pebbles of the sandstone. It is a light gray, harsh-feeling, coarse-grained tuff crowded with fragments of hornblende andesite of a size up to three or four feet in diameter, both angular and worn round and smooth, abundant pebbles of pumice and, locally, pebbles and even cobbles of quartz, granite and gneiss, or of the tuff itself. About a half mile south of Wagon-bed Spring, a five-foot bed of coarse fragments of white pumice occurs near the top of the flow. This may be traced southerly along the crest of the escarpment for some distance. Probably there were repeated mud-flows down the same valley, as what looks like a channel of contemporaneous erosion, filled with andesite cobbles imbedded in gray ash, was seen in the agglomerate about two miles south of Wagon-bed Spring.

Thin sections taken from the lava pebbles in the agglomerate show that these are hornblende andesite containing phenocrysts of beautifully zoned plagioclase (average maximum extinction of twin lamellæ as high as 33°), untwinned but sometimes zoned feldspars (perhaps orthoclase), golden brown, intensely pleochroic biotite, dark, olive-green hornblende (the proportions of biotite to hornblende varying greatly in different slides), a subordinate amount of hypersthene and, finally, abundant black, opaque grains in a ground-mass of fine needles of feldspar and glass. Flow structure is commonly observable, the needles orienting themselves parallel to the margins of the phenocrysts or curving about the ends of the latter. In some slides, large patches of calcite are seen filling cavities (gas cavities). In one highly pumiceous section wisps of glass may be observed penetrating the calcite which has evidently been introduced by secondary infiltration.

As already stated, the agglomerate is absent at Green Cove (Plate VI and Fig. 3). In a third section at the head of Muskrat Creek, small patches of andesitic gravel in an ashy-appearing matrix were found overlying fine-grained bluish-gray shale (Uinta?) on the slope and capping isolated buttes in advance of the main exposures of the Oligocene which here abound in coarse gravels containing some andesite but mostly pebbles of granite, various schists, quartzite, etc.

3. *Oligocene Gravels from pre-Tertiary Rocks.*— Such gravels abound throughout the Oligocene beds capping the Sweetwater-Wind River divide at the head of Muskrat Creek and thickly strew the remnant of the old alluvial plain (page 87) at its summit. At Wagon-bed Spring on the great

terrace (page 95) above the agglomerate flow and extending for perhaps a mile north of the spring is a deposit of gravel and cobbles of granite, pegmatite, hornblendic and other gneisses, quartzite, quartz, hornblende andesite and other volcanic rocks in a matrix of coarse sand resembling an arkose, mixed with and overlain by soft ash (Fig. 2 A and Plate IV, Fig. 1, O3). At first it was suspected that the gravels were contemporaneous in origin with the terrace on the surface of which they are exposed, but further study showed that their areal extent was limited, that they were, in places, firmly cemented and, finally, that many large cobbles of granite at the base of the gravel sheet were imbedded in the tuff at the top of the agglomerate flow. Apparently, we are dealing with a channel deposit of Oligocene age, perhaps formed by a stream which had been diverted from its course by the mud flows. As already noted, similar gravels abound in and to the very top of the Oligocene on the divide at the headwaters of Muskrat Creek. Granite pebbles have also been found in the limestone capping of the Oligocene in the Wagon-bed Spring section and further south. The earlier andesitic eruptions may have been followed (perhaps even caused) by an elevation about the headwaters of the streams crossing this portion of the basin of deposition, enabling them to transport coarse gravel and large cobbles which far exceed in size any of those in the conglomerates of earlier age in this vicinity, so far as known, with the exception of the andesite boulders in the agglomerate. Perhaps the Oligocene conglomerates were spread over the floor of the Wind River basin by torrential intermittent streams under more arid climatic conditions than prevailed during the Eocene.

4. *Wind-blown Ash and Dust.*— That explosive vulcanism was still in progress is indicated by the great thickness of fine buff-colored ash and dust above the gravels at Wagon-bed Spring, where 528 feet of such material is found, increasing to 540 feet at Green Cove (Fig. 3). Locally, the ash is still quite unconsolidated, but usually shows considerable calcareous cementation, especially toward the top of the section where it may pass into a tuffaceous limestone. Angular fragments of more or less devitrified pumice, in which a flow structure is beautifully defined, and sharp splinters of isotropic glass make up more than fifty percent of the soft ash. The remainder consists of abundant angular fragments of plagioclase (average extinction of twin-lamellæ ranging from 11° to 23°), water-clear or slightly cloudy orthoclase sometimes including apatite, in one slide a small feldspar granule with cross-twinning resembling that characteristic of microcline, hornblende both dark green and blue-green, olive-green and golden-brown biotite, small fragments of quartz, an occasional particle of hypersthene, and many black opaque grains, probably iron oxide. The harder phase of

the ash, after removal of its calcareous cement by treatment with acid, differs in no respect from the softer material with which it is interstratified. From the abundance of green hornblende, brown biotite and the occasional presence of hypersthene, no doubt is entertained regarding the andesitic character of this ash. The presence of quartz and microcline-like feldspars can readily be accounted for when it is remembered that great quantities of granite and other quartz-bearing rocks were being swept into the basin of deposition from the surrounding mountains and, from the surfaces of these alluvial fans, the wind could readily carry away fine dust to mingle it with material of volcanic origin.

5. *Limestone and Spring Deposits.*— Toward the top of the Oligocene section at Wagon-bed Spring, the ash becomes increasingly calcareous and gives place to sheets of tuffaceous limestone or layers of white nodular masses, calcareous without, but, when broken open, found to contain more or less silica, both opaline and chalcedonic. Pipes of siliceous material are also seen penetrating the limestone. South of the road-crossing known as Government Slide, the limestone forms the rim-rock of several buttes and mesas seen in the background, at the right-hand side of the picture, in Plate IV, Fig. 2 and, closer at hand, in Plate V, Fig. 2. In the last-mentioned view, an angular unconformity is shown between the limestone and the tuff below, the latter dipping to the west or northwest. This appears to be local. Many quartz, feldspar and pink granite pebbles may sometimes be found in the limestone. It weathers into irregular slabs and honey-combed masses deeply etched by solution. When treated with hydrochloric acid, it dissolves readily leaving a fine gray dust and many delicate, moss-like aggregates of snow-white, isotropic silica. The gray dust, when examined microscopically, is found to be ash, abounding in glass splinters, pumice wisps, and the same association of minerals as occurs in the soft, wind-blown ash already described.

In Granger's preliminary report,[1] the limestone is referred to as "marl," interbedded with sandstones and shales (see section page 89) which have since proved to be ash beds. The term marl, in so far as it implies organic origin from fragments of fresh-water shells, is, probably, inapplicable. While careful search might show the presence of such shells in this limestone, none have yet been found. It seems more probable that it has been formed by waters carrying carbonates in solution, the evaporation of which, at or near the surface, has produced the limestone. A somewhat similar occurrence is described by Rogers and Du Toit in Cape Colony, South Africa,[2]

---

[1] *Loc. cit.*, section, p. 237.
[2] An Introduction to the Geology of Cape Colony, 2nd Edition, pp. 401–404, 1909.

in which local replacement of the carbonate by opal and agate has taken place. Such replacement by opal and chalcedony was repeatedly observed in the limestones of the Beaver Divide. Cylindrical pipes of silica were seen cutting through the limy layers and delicate moss-like aggregates of opaline silica were dissolved out of the massive limestone on treating the latter with acid. Probably the source of both limestone and silica is to be sought in the thick beds of ash from which they were brought to the surface by percolating waters. The silica may, perhaps, have been deposited by springs.

The formation of the limestones of the Beaver Divide by the method suggested above may imply a dryer climate during the Oligocene, with more intense evaporation of waters brought to the surface by capillarity, than prevailed during the Eocene. In the latter, stream-channel deposits and fine water-laid clays are abundant. No clays have yet been found in the Oligocene, but only wind-laid ash and coarse gravels, perhaps to be regarded as alluvial fan deposits formed by torrents during occasional heavy rains. It is desirable to point out, however, that we are familiar with but small fragments of a once extensive formation, and that generalizations regarding Oligocene climate which are based on these have a necessarily insufficient foundation.

THE LOST CABIN SECTION OF THE WIND RIVER.

In contrast with the arkoses which characterize the Wind River in the Beaver Creek and Beaver Divide areas, the extensive exposures of this formation at the northerly margin of the basin of accumulation, south of the Bridger Range, in the valleys of Poison, Alkali, Badwater, Bridger and Lysite Creeks (map, Fig. 1) are, so far as the coarse sediments are concerned predominantly quartzose. The beds consist of the usual highly-colored clays, often alternately banded red and blue, interstratified with pale greenish, buff and yellow-brown sandstones in more or less continuous lenses. The clays show no appreciable difference from those already described from the Wind River. The red clays are often mottled with green or show green zones along joints or as irregular lines branching through the clay. Both red and blue clays may be fine-grained and highly plastic or gritty from mixture with quartz and feldspar grains. They abound in small, irregular, calcareous concretions which weather out and strew the badland slopes. The sandstones interstratified with the clays are composed largely of quartz sand, highly angular to subangular, with subsidiary feldspar and a little chlorite and biotite. In only a few of the specimens ex-

amined was feldspar in excess of quartz. Fragments of pre-Tertiary rocks are rare. Only one conglomerate was seen, composed of highly angular fragments of white quartzite and chert, small round pebbles of coarse sandstone and many round grains of quartz sand with their surfaces roughened by secondary growth. A fragment of a silicified fossil shell was also found among the rock fragments and sand grains.

Granger [1] has separated certain beds exposed along Cottonwood Creek (see map, Fig. 1) north of Lost Cabin, characterized by the absence of *Systemodon* and *Lambdotherium*, from the typical Wind River along Alkali Creek where *Lambdotherium* is abundant. They comprise yellow, gray and brick-red shales or clays with interstratified buff, pale blue, yellow-brown and gray sandstones, dipping at a low angle away from the Bridger Range and passing *beneath* the bluish shales and gray and yellow sandstones with *Lambdotherium* along Alkali Creek. These, in turn, lie *below* the red and blue banded beds, also with *Lambdotherium*, forming the divide between Alkali and Poison Creeks north of Moneta. Throughout there is conformable superposition.

With regard to the faunistic basis for separating the Cottonwood Creek exposures from the rest of the Wind River Granger [2] writes: — "A preliminary study of this fauna shows two points of interest. *First.* All of the genera from these beds are common to the Lambdotherium zone and to the Coryphodon zone of the Bighorn Wasatch. *Second.* The affinities of the species are, in general, closer to those of the latter than of the former zone. The absence in these collections of *Lambdotherium*, one of the most common forms, and of *Eotitanops*, a not uncommon genus of the Alkali Creek beds but a few miles distant, clearly indicates that these Cottonwood Creek beds belong to a faunal horizon distinct from the Lambdotherium zone. On the other hand, the absence of the equally common *Systemodon* of the Bighorn Wasatch makes it difficult to correlate the beds with the Coryphodon zone. They appear to be intermediate between the two zones with none of the characteristic faunal features of either."

As the beds on Cottonwood Creek lie below and are faunally distinct from the Lambdotherium zone, it seems desirable that they should have a formation name, and, as Cottonwood is preoccupied, we propose **Lysite**, from Lysite Creek where the beds are well exposed. For the *Lambdotherium* zone which has hitherto been synonymous with Wind River, we propose the formation name **Lost Cabin**, from the village of that name to the east of which are the main exposures of the beds affording *Lambdotherium.*

---

[1] *Loc. cit.*, p. 245.
[2] *Loc. cit.*, pp. 245, 246.

Both the Lysite and Lost Cabin are grouped as stages of the Wind River series, as they are conformable.

The type area of the Lysite formation is on Lysite and Cottonwood Creeks, north of Lost Cabin. The beds comprise in descending order:[1]—

Yellowish and gray sandy shales covered with a heavy mantle of pebbles from the older rocks of the mountains.....50 ft.

Alternating buff sandstones (1 ft. to 5 ft. in thickness) and red and blue-gray shales.....200 ft.

Gray and dark brick red sandy shales (red predominating) and gray sandstones.....100 ft.

Dull colored, deeply disintegrated clays with some feldspathic sandstone and much gypsum.....thickness undetermined.

Pre-Tertiary rocks of Bridger Range.

The type area of the Lost Cabin formation is to the east of Lost Cabin along Alkali Creek and on the divide between Alkali and Poison Creeks. The Wind River of the Beaver Divide from the level of the Lambdotherium fauna (Fig. 2 A) to the base of the yellow arkose which may be referable to the Bridger belongs to the Lost Cabin stage, as does also the Wind River of the Bighorn basin (see page 108).

Deformation of the Wind River.

Between Lysite and Cottonwood Creeks north of Lost Cabin the slight southerly dip of the Lysite formation suddenly changes to north, producing a narrow syncline, of which the southerly limb dips to the north at an angle estimated at 10°. The beds soon flatten out and continue with their usual low southerly dip beneath the Lost Cabin formation (Lambdotherium zone). This syncline does not seem to be due to irregularities in the surface of the depositional basin and may have resulted from a post-Wind River elevation of the Bridger Range.

THE EOCENE–? OLIGOCENE SECTION OF THE BIGHORN BASIN.

The Floor of the Eocene Basin.

The Bighorn Wasatch occupies a structural depression, the floor of which was modified by erosion subsequent to the main uplift of the Bighorn Mountains, occurring after the deposition of the Fort Union. At several

[1] Section measured by Granger. *Loc. cit.*, p. 245.

points where the pre-Wasatch basin floor can be seen, the basal conglomerate or sandstone of the Wasatch rests on a level surface carved across the uptilted edges of Fort Union beds. A splendid section, showing the contact, may be examined on Antelope Creek, about two miles southwest of the town of Basin (Plate IX, Fig. 1). At this locality, the Fort Union shales and sandstones dip to the west at an angle of 35°. The Wasatch contact plane also dips westerly, but at an angle of 1°, increasing to 8° toward the easterly margin of the basin. A yellow-brown quartzose sandstone forms the basal member of the Wasatch, succeeded by yellow-weathering blue clays, frequently lignitic, interstratified with narrow, pale pink clay bands and occasional sandstone lenses. The bedding planes of the Wasatch parallel the slope of the contact plane, increasing with it in dip toward the east. This has probably been produced by an uplift of the Bighorn Range subsequent to the deposition of the Wasatch. More conclusive evidence favoring this assumption is presented in the discussion of the great anticline on Elk Creek discovered by the American Museum party (p. 108). Fisher [1] figures a similar unconformable contact between the Wasatch and "Laramie" (probably Fort Union) at the head of Dry Cottonwood Creek, at the western margin of the Bighorn basin. In southwestern Wyoming, Veatch [2] recognizes "a period of folding and erosion of great magnitude" separating the Coryphodon Wasatch (Knight formation) from the Evanston, Almy and Fowkes formations, also regarded as Eocene and perhaps to be correlated with the Fort Union.

The Bighorn Wasatch.

Owing to a lack of the necessary instruments, no measurement of the thickness of the Wasatch was attempted, but it is probably in excess of a thousand feet.[3] In the area studied, this formation is composed largely of clays varying in texture from fine and unctuous to slightly gritty from intermixture with quartz sand, and in color from pale blue-green through mottled pink and blue to pale pink, bright red and faded purple. Interstratified with the clays are lenses of yellow-brown, blue and gray quartzose sandstone, usually with a calcareous cement but often quite unconsolidated, crumbling at the slightest touch. The lower levels are of a predominantly bluish to yellowish tone owing to the prevalence there of yellow-weathering

---

[1] Geology and Water Resources of the Bighorn Basin. Professional Paper, U. S. G. S. No. 53, pl. x, fig. B.

[2] Geography and Geology of a Portion of Southwestern Wyoming. Professional Paper, U. S. G. S. No. 56, p. 88.

[3] Fisher estimates the thickness of the Bighorn Wasatch at 2000–3000 feet. *Loc. cit.*, p. 8.

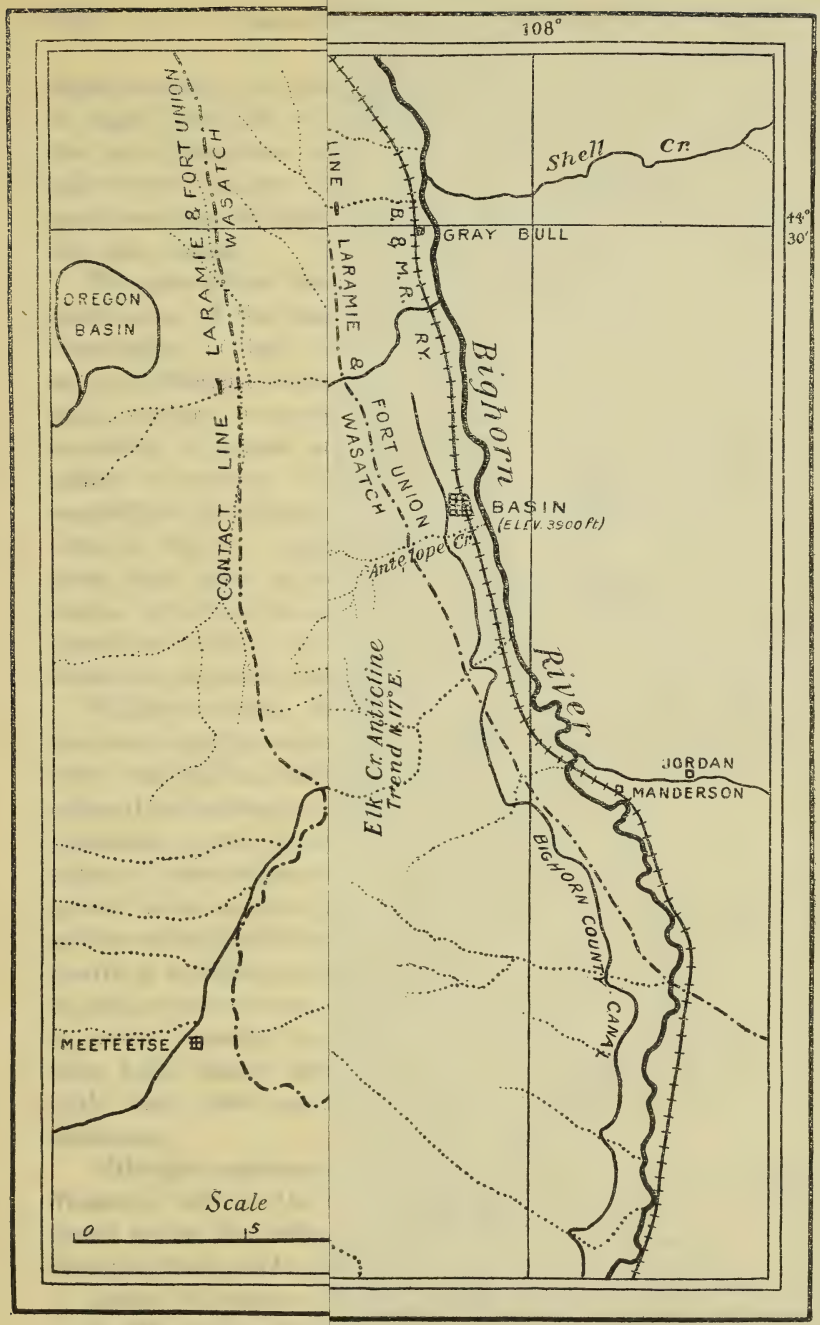
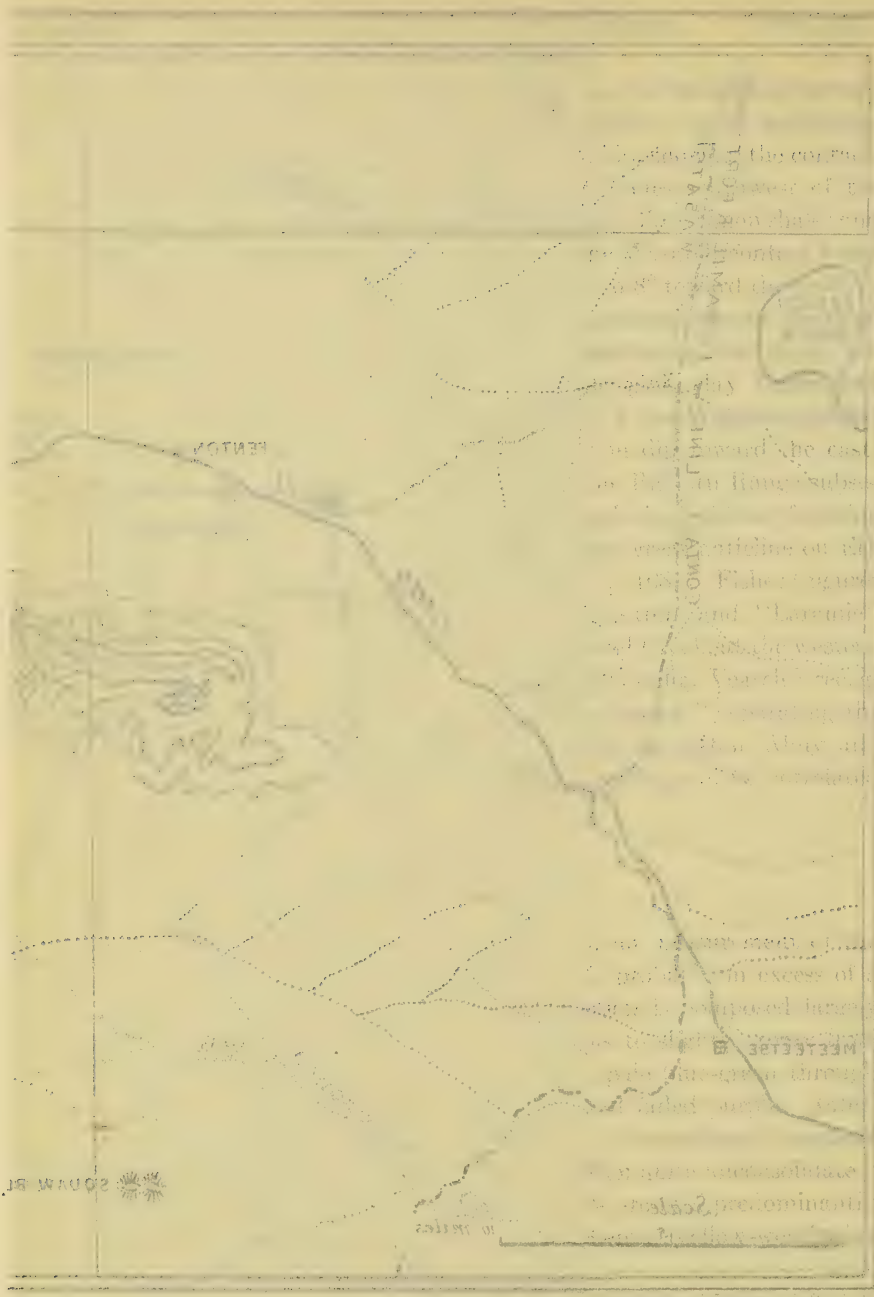


Fig. 4. Sketch of Bighorn basin by C. A. Fisher.

Fig. 4. Sketch map of a portion of the Bighorn basin studied by the American Museum expedition of 1910. Based on a Geologic map of the Bighorn basin by C. A. Fisher.



1500-5000 feet, *Loc. cit.*

blue-green clays, but pink, red and purple banding is by no means absent. At higher levels the red banding predominates, occurring in regular alternation with blue-green or mottled (red and blue) clays, or with lenses of yellow-brown to gray sandstone. The blue clays and, occasionally, the sandstones may be lignitic, but no lignite has been found in the red, purple and pink bands.

The color of the Wasatch clays is due entirely to differences in chemical combination of the iron and not to its state of oxidation. Microscopic examination of both the red and blue-green varieties shows practically no difference between them. In addition to kaolin, varying in color from pearl-gray to rusty red or brown, all contain more or less fine grit consisting of minute angular fragments of quartz. Sometimes a little chlorite is present. Calcareous concretions are exceedingly abundant, especially in the red clays, and strew the badland slopes in countless numbers (Plate V, Fig. 1). Concretionary hematite is quite common in the blue-green clays, either in isolated nodular masses of irregular shape or in association with fossil bones, either coating the fossils or occurring in their immediate vicinity, but not deposited on the bones. It is sometimes found also on bones from the red and mottled clays.

Without exception, the Wasatch sandstones are predominantly quartzose, the quartz grains varying in shape from angular to round and, in almost every case, having their surfaces roughened by secondary quartz growths oriented in conformity with the crystallographic axes of the original grains, producing crystal facets and even complete crystals with double rhombohedral terminations with or without the prism zone. This secondary growth seems to have taken place after the deposition of the sandstone as the crystal facets show no signs of abrasion. Owing to the secondary quartz, it is difficult to determine whether the round grains owe their shape to wind or water wear. In addition to quartz, much feldspathic material is present, usually in an advanced state of kaolinization. Decomposed mica foils, chlorite grains and small angular fragments of dark-colored shale, black chert and brown quartzite may also be found, but in less abundance.

Although conglomerates and gravels are known to occur in the Bighorn Wasatch,[1] both at the base and higher up in this formation, none were found within the limits of the area studied with the exception of a few flattened shale pebbles near the base of a large sandstone lens.

Faunal Horizons.— In the diagram (Fig. 2 B) three faunal horizons in the Wasatch are indicated by conventions and numbered consecutively

---

[1] Fisher, *loc. cit.*, p. 33 and pl. x, fig B. Loomis, *loc. cit.*, p. 360, No. 12 of section.

from 1 to 3. These are based on series of levels where fossils were particularly abundant, but apart from the assistance they afford to the collector and palæontologist, have little additional interest. For reasons stated on an earlier page, it was not possible to ascertain their thickness nor can their stratigraphic limits be strictly defined. The facts regarding superposition, indicated in the diagram, are, however, well established. Horizon 1 is exposed on both sides of the lower valley of Elk Creek, and passes over the Elk Creek anticline (p. 106). Horizon 2 extends from Dorsey Creek above Hal Blakesley's ranch to Elk Creek and is known to be higher than Horizon 1. The third horizon is best exposed in the badlands south of Saint Joe P. O. and is but little higher than Horizon 2.

The Bighorn Wind River.

The presence of *Lambdotherium* in the Bighorn Basin was ascertained by one of the early Princeton expeditions.[1] Five specimens of *Lambdotherium primævum* (=*L. popoagicum*) were collected by Dr. Loomis in Buffalo basin at a level higher than those affording the typical Wasatch fauna. He, therefore, suggests that the uppermost 1000 feet of the section belongs to the Wind River.[2] It remained for the American Museum expedition to definitely establish the presence of the Lost Cabin stage (Lambdotherium zone) of the Wind River in direct stratigraphic conformity above the true Wasatch in the area of high badlands north and northeast of Tatman Mountain (Plate IX, Fig. 2), where the following species were secured from horizons ranging from the top of the alternately red and blue banded clays, immediately beneath the lignitic shales described in the following section, to a point 320–325 feet below this level: —

Lambdotherium popoagicum	2 specimens.
Heptodon ventorum	several specimens.
Eohippus	2 species, both primitive.
Hyopsodus cf. powellianus	2 specimens.
?Stylinodon	1 "
Paramys sp. a	1 "
Paramys sp. b.	1 "
Crocodile	1 "

Of the two specimens of *Lambdotherium popoagicum* secured, one was found about 25 feet below the top of the Wind River as defined above and the other about 319 feet below the top. It would seem, therefore, that

[1] Unpublished data communicated by Professor W. B. Scott.
[2] Loomis, *loc. cit.*, p. 357, 362.

Loomis's[1] figures for the thickness of the Wind River in the Bighorn Basin (325 feet) are, approximately, correct.

Were it not for the presence of *Lambdotherium* and *Heptodon,* of which no specimens were found by the American Museum party in the Wasatch, it would be impossible to differentiate the Wind River from the Wasatch either lithologically or stratigraphically. At present, the line of separation is determined by the vertical range of *Lambdotherium.* The fauna of the Lysite stage has not been identified in the Bighorn Basin but may occur in the 600 feet of sparingly fossiliferous beds between the Lambdotherium zone and the richly fossiliferous Wasatch bench indicated by the asterisks in Plate IX, Fig. 2.

There is no lithologic difference by which the Wasatch and Wind River can be separated. Sedimentation seems to have been a continuous process, the fauna alone changing. A coarse-grained pebbly sandstone occurring at a level above the second specimen of *Lambdotherium* secured by us is worthy of special mention from the insight it affords regarding the source of the Wind River sediments. It is a feebly coherent rock with much calcium carbonate cement, composed of small pebbles and angular fragments of brown and salmon-pink quartzite, white and black chert, banded chalcedony, micaceous sandstone, quartz-feldspar and mica-feldspar pegmatite, a few fragments of what seem to be a much decayed igneous rock, several flattened pebbles of light-colored shale with dendrites, a small silicified gastropod shell (pre-Tertiary), mica foils, numerous quartz grains angular to round with crystal facets and often doubly terminated, secondary quartz obscuring the original surface of the round grains, abundant feldspar, dull white but not soft and crumbly, many deeply kaolinized particles, and a few splinters of pink garnet, an association of materials derived manifestly, in greater part, from the Palæozoic rocks of the Bighorn or Bridger-Owl Creek Mountains.

Post-Wind River Lignitic Shales.

On the north and northeast sides of Tatman Mountain, the Wind River is capped by a bed of buff-colored sandstone overlain conformably by about 600 feet (730 feet according to Loomis's aneroid readings) of yellowish-brown lignitic shales and sandstones containing sufficient carbonaceous matter to have induced some little prospecting.

Fisher[2] refers to these beds as follows:

---

[1] Numbers 4–11 of Loomis's section, *loc. cit.*, p. 360 are Wind River.

[2] *Loc. cit.*, p. 34.

"Capping some of the highest areas in the central part of the Bighorn basin, especially that part lying south of the Grey Bull River, are brown, leaf-bearing, sandy shales and gray sandstones, which have a total thickness of about 600 feet. Thin coal seams sometimes occur in these beds, and in one locality on the southern side of Tatman Mountain some prospecting has been done in a seam which has a thickness of about 18 inches. A number of fossils were collected from the sandstones of this formation in the vicinity of Squaw Buttes. These have been examined by Dr. T. W. Stanton, who makes the following report:

"The small collection contains many internal casts of fresh-water fossils belonging to the genera *Unio*, *Viviparus* and *Goniobasis*. Of the last named there are imprints of the exterior which permit identification with *G. tenera* Hall, an Eocene species. The *Unio* has about the size and proportions of *U. haydeni* Meek and the *Viviparus* resembles *V. wyomingensis* Meek, but in neither case can positive identification be made with such material, as there are Laramie species so closely resembling these that they could not he discriminated from the casts alone. I think that the horizon is Eocene, but I am unable to determine from these fossils whether it is Wasatch or Bridger.

"These beds are extensively exhibited in Tatman Mountain and Squaw Buttes."

Poorly preserved remains of ostracods and phyllopods have been found by Professor G. van Ingen in a specimen of pale pink shale collected near the base of this formation on Tatman Mountain. The possibility of these beds being Wasatch is ruled out by their stratigraphic position above the Wind River. That they may correspond to the Bridger is possible, and they are, perhaps, to be correlated with the so-called Bridger of the Beaver Divide section. They are separated from the gravels capping Tatman Mountain (Fig. 2 B) by about 30 feet of unconsolidated, highly micaceous, greenish sandstone containing abundant foils of chloritized biotite, decomposed muscovite, many quartz grains and both fairly fresh and kaolinized feldspar. From its stratigraphic position this sandstone may possibly be Uinta, but the assumption is entirely unconfirmed by palæontological data. Only small remnants of both the lignitic shales and the greenish sandstone capping Tatman Mountain, Squaw Buttes and other high points have been spared by erosion. So far as at present observed, the sandstone seems to be conformable with the lignitic shales. The latter are usually conformable with the Lambdotherium zone, but on the northwest side of Tatman Mountain local dips in the Wind River were observed which did not conform with the flat-lying shales above. Their significance has not yet been fully ascertained.

Tatman Mountain Gravels.

Tatman Mountain is capped by about 30 feet of stream gravels resting unconformably (?) on the lignitic shales below. While the majority of the pebbles are of volcanic rocks, no particularly careful search is necessary to demonstrate the presence of vein quartz and quartzite. Four of the volcanic pebbles, gathered at random, have been sectioned. All prove to be hornblende-augite andesite in which the lath-shaped plagioclase phenocrysts (average maximum extinctions ranging from 26°–36°) have their long axes similarly oriented due to flowage of the mass before cooling. The few large hornblende phenocrysts are encircled by heavy resorption wreaths which sometimes inclose masses of chlorite. Much chlorite and fine black dust is present in the ground-mass in certain of the slides. Augite is moderately abundant. The ground-mass is composed largely of fine feldspar needles. These lavas differ from the andesite of the Beaver Divide Oligocene in the presence of augite instead of hypersthene, in the absence of biotite and in the scarcity and evident decomposition of the hornblende. They have been more decomposed and may be older. As no fossils have yet been found in the Tatman Mountain gravels and nothing in the shales below but traces of plants and a few invertebrates, their age cannot be fixed, and the questionable assumption that they are Oligocene (diagram, Fig. 2 B) is based entirely on their stratigraphic position above beds which may correspond to the so-called Bridger and perhaps also the known Uinta of the Wagon-bed Spring section in the Wind River basin. The exposures on Tatman Mountain are but fragments of a formation at one time more extensive, but now almost entirely destroyed by erosion.

DIASTROPHIC MOVEMENTS INVOLVING THE EOCENE IN THE WIND RIVER AND BIGHORN BASINS.

Attention has already been called (p. 105) to a narrow marginal syncline involving beds of the Lysite stage in the Wind River basin north of Lost Cabin. A marginal anticline of much greater extent was discovered by the American Museum party (see map, Fig. 4) trending across the lower valley of Elk Creek about four miles from its mouth, in a direction N. 17° East (true meridian) and at least four miles across between the steepest dipping portions of the east and west limbs which are inclined respectively at angles of 7° and 5° 30′, flattening out to the east and west. This fold may be known as the Elk Creek anticline. It has probably been produced in the same way as the oversteepened dips on the margin of the Wasatch

basin (Plate IX, Fig. 1) on Antelope Creek by a post-Wasatch uplift of the Bighorn Range with compression of the marginal portions of the adjoining intermontane trough. As the Wind River sediments have been eroded from the area including the Elk Creek anticline, it is not possible to say whether the folding was an event of Wasatch or Wind River time. About the periphery of the basin, the dips of the Wasatch are usually at low angles toward the center of the trough where the beds are, with few exceptions, practically horizontal.

Minor gravity faults were noted occasionally. Their presence can frequently be detected by small vertical ledges of hard slickensided shale standing up in relief an inch or so above the crumbling, mud-cracked surface of the Wasatch clays.

Perhaps to be correlated with the accumulation of the deformative stresses producing faulting and folding is the occurrence in the Wasatch of numerous sandstone dykes (Plate VIII, Fig. 2). These are similar lithologically, in all respects, to the Wasatch sandstones already described. In one instance, a narrow dyke, cutting clays, was traced downward to confluence with an underlying sandstone lens. They appear to have been forced up as quicksands through cracks produced by earthquakes. As suggested above, the earthquakes which produced the dyke fissures may have been associated with the action of mountain-making stresses or they may have been due merely to the settling down of unconsolidated sediments.

LIFE CONDITIONS IN THE WIND RIVER AND BIGHORN BASINS DURING THE EOCENE AND OLIGOCENE.

Origin and Mode of Deposition of the Sediments.

From the foregoing discussion it may readily be gathered that the Eocene sediments represent materials derived by erosion from the older rocks of the mountains and deposited in the intermontane basins. This is particularly well shown in the association of rock species found in the coarser sandstones and arkoses of the Wind River and Bridger (?), where Archæan granites and Palæozoic quartzites are readily recognizable. The well-rounded gravels found in some of the arkoses point with equal certainty to running water as the transporting agent while fluviatile deposition is shown by the frequent channels filled with coarse sandstone which cut irregularly across the finer clays, by the frequent interstratification of sandstone lenses with the clays and by the presence in the latter of fish, crocodiles and turtles, and occasional beds of *Unio*. Local swamps are

indicated by lignites in the blue clays and sandstones, but never in the red clays.

As the source of the detrital materials remained constant, increase in the size of the constituent particles in the sediments must have been due either to climatic causes affecting the volume and transporting power of the streams or to steepening of the stream grades as a result of uplift, while differences in color must be due to chemical changes acting within the basin of accumulation and, accordingly, local in character, or to variations in climate affecting the region as a whole. It is not always possible to determine whether one factor has acted to the exclusion of the others; for instance, the coarse, frequently cross-bedded arkose forming the lower member of the so-called Bridger of the Beaver Divide appears to represent a series of conjoined alluvial fans spreading out over the banded clays of the Wind River, but it is not possible to say whether the gravels and sands were transported by torrential streams under a dry climate or by streams whose carrying capacity had been increased by uplift. From the freshness and high degree of angularity of many of the feldspar fragments in the arkoses and sandstones described in the pages preceding, it seems permissible to deduce the following inferences: — *First.* It may be assumed from the angularity of the fragments that they have not been transported far. Archæan granites are exposed in the mountains at no great distance from the basin floors. *Second.* From the freshness of the feldspars, it may be assumed that they have not been leached by carbonated waters, such as might be expected to occur if they were deposited in a region of high humidity, and that they have not been derived from the parent granite by ordinary weathering processes, but rather by temperature changes which would shatter the minerals without affecting their freshness. The condition of the feldspars, therefore, does not favor the idea of luxuriant Eocene tropical forests and a warm, humid climate, with the formation of a deeply decayed regolith, but suggests a dry, not necessarily arid, climate with rapid changes of temperature to splinter the parent ledges, rapid transportation of the fragments for short distances and their burial beyond the reach of carbonated waters.

In the Wind River basin, wash from the mountains continued to be spread over the basin floor by streams until the close of the Uinta. The interposition of two small ash beds found in the Wind River and Bridger (?) respectively did not affect the character of the depositional cycle in the least. After the erosion of the broad valleys in the Uinta (p. 86) wind rather than water seems to have been the chief transporting agent. The Oligocene tuffs are, in part, wind laid. Such turtle remains as were found in them were confined to the ashy filling of the post-Uinta valleys below

the agglomerate flow. Above the level of the agglomerate, wind transportation assisted by occasional torrents heading in the mountains where granites and Palæozoic quartzites are exposed were the principal agents responsible for the 525–540 feet of beds above the agglomerate layer. The rolled boulders and pebbles in the latter indicate aqueous transportation, but the source of the waters which carried them is probably to be found in the deluges of rain which accompany volcanic eruptions, due to condensation from the steam clouds. Neither the Oligocene ash nor the associated gravels show evidence of having been weathered to any appreciable extent since their deposition and we are inclined to believe that they were accumulated under a dryer climate than prevailed during the Eocene. The most reliable piece of evidence favoring this view is to be found in the limestones which cap the Beaver Divide. No fresh-water shells have been found in these so far, but ash is always present and gravels frequently so. We regard these limestones as having been formed by evaporation, at the surface, of calcareous waters rising in response to capillarity. Remnants of the old basin floor at the close of Oligocene sedimentation are preserved in the flat gravel-strewn summits of the Beaver Divide. Whatever fine silt may have originally been mixed with the gravels has been largely removed by the wind. The cobbles still show the bruises produced by their striking together in the torrential streams which swept them over the Oligocene basin floor.

In the Bighorn basin, fluviatile deposition is indicated for the entire Eocene. The lignitic shales which cap the Lambdotherium zone, from their fresh-water molluscs, entomostraca and plant traces, are quite certainly both fluviatile and palustrine. The Tatman Mountain gravels are, with equal certainty, of stream origin, but whether deposited under moist or dry climatic conditions is not apparent.

Source of the Color-banding.

Frequent reference has been made to color-banding in the Wasatch and Wind River clays. This consists in a more or less regular alternation of beds of red and blue-green clay or of red with mottled clay (red and blue-green). The red clays are frequently streaked with blue-green color along joint cracks or are traversed by anastomosing green lines along what may have been the courses of roots. The beds are lenticular in shape, varying from a few inches in thickness, with little horizontal extent, to strata from 18 inches to 50 feet in thickness, traceable sometimes for several hundred yards to a mile or more. One persistent purplish band, passing over the Elk Creek anticline may be followed for several miles. Lignite is never

found in the red clays but may be present in the blue. In the Wasatch, where fossils were obtained at many horizons in the red, blue and mottled clays, it is noticeable that those from the red clays, while at times abundant, are always fragmentary, the more resistant parts such as jaws and teeth predominating. In the blue and mottled clays associated skeletons may be expected and many of *Coryphodon* were found.

So far as mineralogical composition is concerned, the microscope has failed to reveal any essential difference between the variously colored clays. Chemical examination by Professor A. H. Phillips has produced some unexpected results regarding the chemical condition of the iron content of the clays, to which alone the color is due. The results of the analyses with respect to iron may be tabulated as follows:

Iron determinations. Wasatch and Wind River clays, from Natrona and Bighorn Countries, Wyoming. A. H. Phillips, analyst, March, 1911.

Horizon	Phase	Total Iron Calculated as Fe_2O_3	Total Iron FeO*	Total Iron Fe_2O_3
		%	%	%
1. Mottled (red and blue) clay, Lost Cabin stage, Wind River formation, east of Lost Cabin.	Red	8.16	0.19	7.91
	Blue	6.67	0.38	6.24
2. Blue clay, Wasatch, south of St. Joe P. O., in badland area northeast of Tatman Mountain. Headwaters of Dorsey Creek.	Blue	3.34	0.52	2.77
3. Red clay, Wasatch, south of St. Joe P. O., in badland area northeast of Tatman Mountain. Headwaters of Dorsey Creek.	Red	4.82	0.58	4.18

*By sealed tube method.

In all the samples examined, the *total iron* in the red clays is in excess of that present in the blue by 1.48 % to 1.49 %. The amount of *ferrous iron* in the blue Wasatch clay is less than that present in the red while in the mottled Wind River clay it is slightly greater in the blue than in the red phase, but in neither case does it seem possible to ascribe the blue color to ferrous oxide as this substance is far exceeded in amount by *ferric iron,*

evidently occurring in the blue clay in some other form than ferric oxide (hematite), perhaps as a hydrous silicate. In the Wasatch clay the red contains 1.41 % more Fe_2O_3 than the blue; in the Wind River clay, Fe_2O_3 in the red phase is 1.67 % greater than in the blue. If this excess of iron is present in the form of hematite, as the red color seems to show, it is possible that the remaining iron in the red clay may be in the same form as in the blue (a hydrous silicate?) and that the blue color has been masked by the red pigment.

The results of analysis seem to show that the blue color has not been derived from the red by reduction of the iron as ordinarily understood. The red color may have been from the blue by conversion of the hypothetical silicate into carbonates by meteoric waters and the subsequent oxidation of these salts, or by the introduction of iron compounds in solution and their concentration and oxidation possibly under dryer climatic conditions than existed during the deposition of the blue clays. We favor the latter alternative and regard the coloration of the clays as a phenomenon controlled by conditions active during the deposition of each individual stratum (red or blue as the case may be) and not by subsequent or secondary changes. Under the arid conditions which exist at present over most of the Wind River and Bighorn basins, the blue clays show no tendency to weather red. The layer of weathered, mud-cracked clay on the surface of badland slopes cut in the blue clays is yellow from the hydrous oxide limonite.

Similar alternations of red and blue clays have been described by Huntington in the desert basins of Lop and Seyistan and the colors associated with a recurrence of moist and arid climatic cycles, the iron salts oxidizing during the arid cycles, producing the red colors. We ascribe the color-banding of the Wasatch and Wind River clays to a similar cause, the alternation of moist and dry climatic conditions, but have not found any evidence of excessive aridity, the fauna of the red and blue bands being the same. The clays cannot owe their color to different sources of supply for they are microscopically the same and the alternation of color bands is too regular and of too frequent recurrence to permit this inference. The red clay cannot represent upland oxidized wash, for waters swift enough to carry the bone fragments found in the clay would also transport rock fragments of some size, and these are not found. From the fact that the blue clays of the Wasatch are sometimes lignitic and often afford associated skeletal remains, we are disposed to regard them as having been formed during cycles of more abundant rain fall when the surface of the intermontane basin was prevented from drying out rapidly. The red clays, we believe, were formed during the dryer cycles when the carbonaceous matter

of decaying plants was completely oxidized, concentration and oxidation of iron compounds occurred, and animal bones exposed at the surface were weathered and broken before entombment. That these conditions were not local is shown by similar color-banding in the Wasatch in other localities than the Bighorn basin.

Occurrence of Organic Remains.

The collections secured from the Wasatch (about 3000 individuals) have shown that vertebrate fossils are particularly abundant at certain levels. In many of the red clay bands or at the contact of red and blue strata, great numbers of fragmentary jaws and scattered teeth were found. Such levels undoubtedly represent portions of the basin floor as it was when these creatures died and their bones were scattered and weathered before being buried. Associated skeletons have been mentioned as of quite common occurrence in the blue clays. These are the remains of animals which were either drowned and rapidly covered beneath fluviatile sediments or were mired in the soft clays. In the Wind River area, where fragmentary material is the rule, the teeth usually have the roots worn away and only the harder enamel-covered crowns preserved. Where *Unio* beds occur in the Wasatch, they are always of limited extent and, so far as we can recall, have never been found in the red clays. The lignite layers in the blue clays are usually mere dirt bands, but some, in the Wind River basin, along Alkali Creek have considerable thickness.

Fig. 1. Beaver Divide north of Wagon-bed Spring showing broad channel cut in the Uinta (U) and filled with Oligocene tuff (O.1) overlain by agglomerate (O.2) and gravels (O.3).

Fig. 2. Looking south along Beaver Divide above Wagon-bed Spring.

Fig. 1. Mud-cracked, concretion-strewn surface of Wasatch clays, three miles south of Otto, Bighorn Co., Wyo. Weathered *Coryphodon* bones in the foreground.

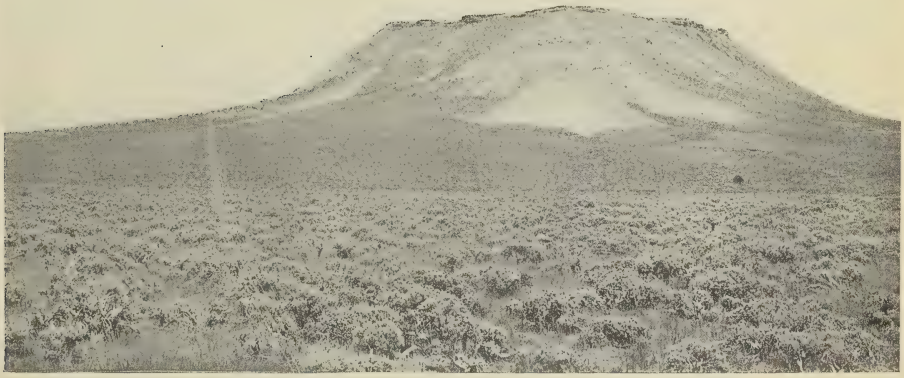
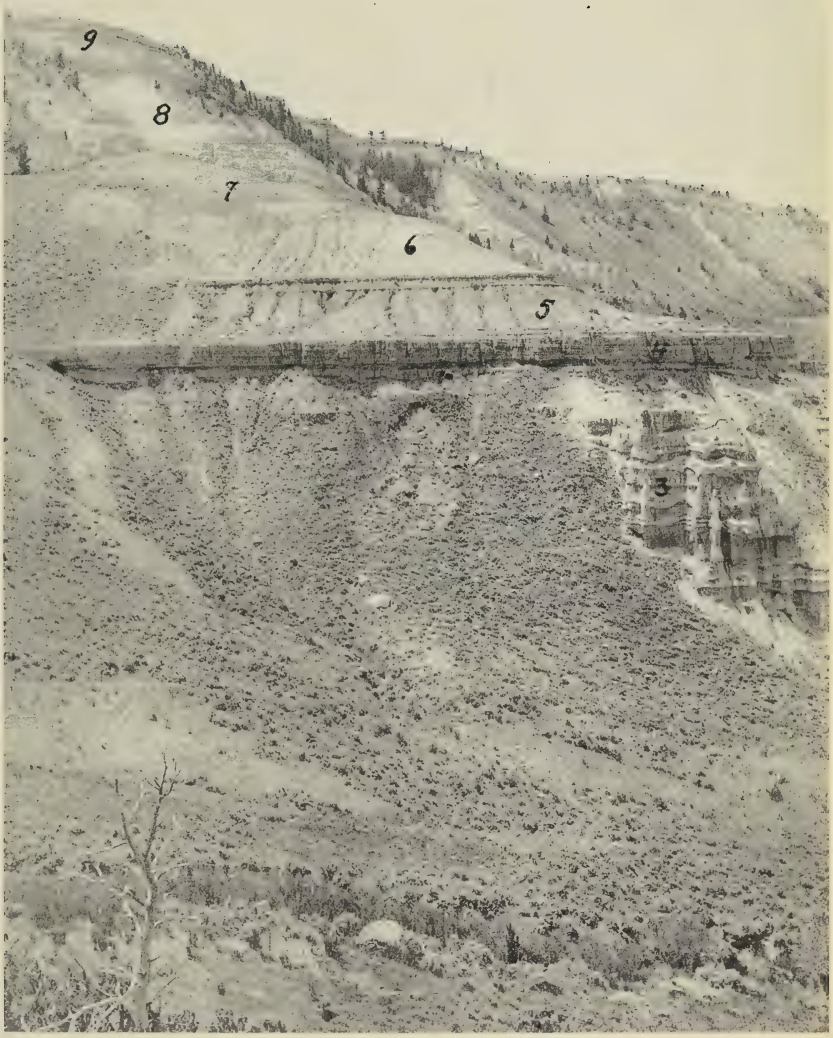


Fig. 2. Pumiceous limestone unconformably overlying slightly consolidated ash. Oligocene. Lone Butte, south of Government Slide road, Beaver Divide. Shows first and second Oligocene-post-Oligocene baselevels.



Eocene-Oligocene section at Green Cove about four miles east of Hailey, numbered to correspond with the section on p. 89 and the diagram (Fig. 3).

Fig. 1. Lambdotherium zone, Wind River badlands, between Beaver Creek and Big Land Draw. The horse stands on the fossiliferous bench.

Fig. 2. Arkose-filled stream channel in banded Wind River clays between Beaver Creek and Big Land Draw. The fauna of the Lambdotherium zone occurs in the clays at the foot of the bluff.

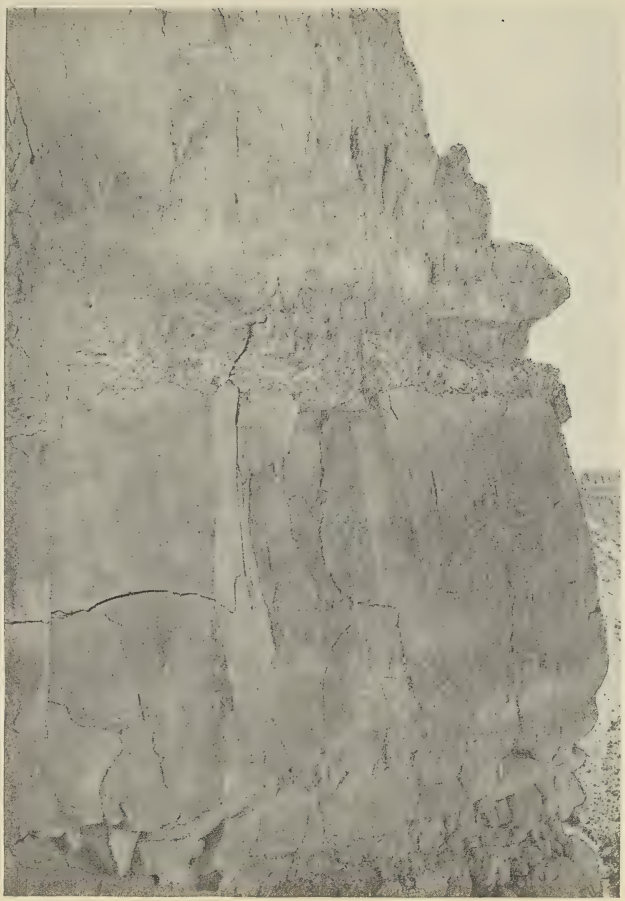


Fig. 1. Contact of the Oligocene andesitic tuff (O) and the Uinta sandstone (U) showing the basal tuff conglomerate. Above Wagon-bed spring, Beaver Divide.

Fig. 2. Sandstone dyke cutting Wasatch clays. Badlands south of Elk Creek.

Fig. 1. Unconformable contact of Wasatch on Fort Union. Antelope Creek, about two miles southwest of Basin, Bighorn Co., Wyoming. Showing the floor of the Eocene basin of accumulation.

Fig. 2. Wasatch-Wind River badlands north of Tatman Mountain. The arrow points to the contact of the Wind River. The dark bands are red clays. Remains of 30 individuals of *Eohippus* were collected in one day from the Wasatch bench marked by asterisks.

59.82:15.7
59.9 :15.7

Article VIII.—REVEALING AND CONCEALING COLORATION IN BIRDS AND MAMMALS.

By Theodore Roosevelt.

CONTENTS.

	Page
Introduction: Statement respecting concealing, or protective, coloration	120
The doctrine of concealing coloration as stated and applied by G. H. and Abbott H. Thayer in their 'Concealing Coloration in the Animal Kingdom'	121
Misstatements of facts as set forth by them pictorially and in their text	123
Examples: Pictures of peacock, zebra, chickadee at nesting-hole, oyster-catcher, wood duck, flamingoes, spoonbills and ibises, blue jay, etc.	124
Flank markings of ducks, etc.	129
Head and bill and leg markings in rapacious birds	129
Effect of iridescence in birds	130
General comment on pictorial effects, and on the authors' interpretations of them	131
The rôle of countershading	132
Concealment due mainly to cover and habits	134
All colors sometimes concealing	139
Effect of size; examples: antelope and other big mammals	140
Effect of cover and habits; examples: ostrich, bustards, cranes and other large birds; rails and other skulking birds, etc.	143
The advertising coloration of oyster-catchers, stilts, avocets, ducks, geese, etc.	147
Diverse colors of small birds living in similar surroundings	150
Coloration of woodpeckers not obliterative	160
Nuptial colors advertising, not concealing	162
Nesting and young birds in reference to their coloration	164
Patterns of color and ornaments in the animal world not "scraps of imitation scenery"	166
Marine mammals not "obliteratively colored"	169
Size and coloration in mammals in relation to conspicuousness	170
Countershading plays an inconspicuous part in the concealment of mammals	172
Advertising marks in the pronghorn, deer, antelope and other ruminants	175
Coloration of the cougar not at all times "concealing"; its adeptness at concealment due to nocturnal habits, wariness and acute senses	181
Important bearing of the cougar's life history upon problems of concealing and advertising coloration	182
Coloration and concealment as illustrated by American and African big game	184
Coloration of giraffe and zebra not concealing	191
List of big game studied	198

Page
Rear-end color of rabbits not obliterative, but advertising . . . 201
Skunks, ratels and zorillas advertisingly, not obliteratively, colored . 204
Coloration of squirrels, spermophiles, marmots, etc. 206
Recapitulation 208
Conclusions 212
Appendix: Reply to criticisms of A. H. Thayer in 'Popular Science Monthly' for July, 1911 221

Introduction.

In presenting certain observations bearing on the question of concealing, or protective, coloration in birds and mammals, let me at the outset explain that I do not doubt that as regards certain birds and mammals, and very possibly as regards the larger proportion of the lower forms of animal life, concealing coloration plays an important part. I am convinced, however, that this part has been largely, and by some persons absurdly, exaggerated. The limitations within which the theory can probably be held to apply have been disregarded; and the other, and often conflicting, influences, which have been at work side by side with tendencies which have produced concealing coloration, have been partially or completely ignored.

Sufficient attention has not been paid to certain wide differences of possibility in concealing coloration as affected by the animal's habits. A caterpillar which passes its entire caterpillar life on green leaves or in immediate proximity to them may be most effectually concealed on all occasions by being green. Its own activities are so slight, and its habitat so circumscribed, that it is a simple thing to equip it with a concealing coloration. Higher up in the scale, a tree toad or a wood frog or a green frog are all unquestionably concealingly colored as regards their upper surfaces, and have precisely the coloration that best equips them for concealment under the conditions that surround them during by far the larger part of their lives.[1]

But among the higher animals many species have such a wide range of activities, and continually pass over such totally different landscapes and among such totally different surroundings, that the difficulty of devising any concealing coloration would be enormous. For example, consider a wide-ranging hawk like the sharp-shinned hawk, or a wide-ranging carnivore like a wolf. The hawk passes in and out among woods, orchards, gardens, over plains, over meadows and pastures and along hedgerows; it is active in the bright green of summer, and among the snows of winter; in short, no

[1] This does not mean that I admit that all reptiles are protectively colored. One of our common snakes, the black snake, for instance, is certainly advertisingly colored, and the whole subject of concealing and advertising coloration amongst reptiles is worth serious study by competent and unprejudiced observers.

pattern and no coloration could always, or even generally, be concealing, and the coloration and pattern it actually possesses have practically no concealing effect whatever. A wolf hunts in the green spring and in the snowy winter, on the open plains and in the thick woods, amid all conceivable surroundings of every conceivable color. Perhaps under such circumstances a nearly uniform but slightly countershaded khaki or drab or gray color would be most concealing or obliterative; and there are wolves with such a type of coloration. But there are also black wolves and white wolves, red wolves, brown wolves, and wolves of a conspicuous iron-gray; while hawks, kites, and eagles are found of many different and exceedingly conspicuous colors and combinations of colors, their coloration patterns being in a very large number of cases of a more or less advertising character, and, under the actual circumstances of their lives, rarely having any obliterative or concealing effect. It thus appears that to hawks and wolves, the question of coloration is of no moment, as regards perpetuating their lives; they depend upon the keenness of their senses, their cunning, their dash, endurance, hardihood, and the formidable nature of their weapons. It is evident, therefore, that the conditions of life as regards concealment are so utterly unlike in the case of a hawk or a wolf as compared with the case of a tree toad or a wood frog or caterpillar that any attempt to lay down a universal law of coloration which would include them all must be entered upon with extreme caution; and yet this is exactly what has been attempted by certain modern writers in the most sweeping terms and with a curiously complacent recklessness.

I propose to discuss purely birds and mammals as affected by the question of coloration. I use the word "concealing" as including both conscious and unconscious forms of concealment; and I use the word "advertising" merely as expressing the opposite of "concealing," that is as any kind of conspicuous coloration which instead of concealing the wearer from attention tends to attract attention without regard to whether the wearer is, or (as is probably much more often the case) is not, conscious that his coloring or any part of it does attract attention. The word "revealing" would express my meaning as well as the word "advertising."

The Doctrine of Concealing Coloration as Stated and Applied by G. H. and Abbott H. Thayer in their 'Concealing Coloration in the Animal Kingdom.'

The doctrine of concealing coloration as an explanation of almost every kind of coloration in the animal kingdom has received its widest application in the book called 'Concealing Coloration in the Animal Kingdom,'

by Messrs. Gerald H. and Abbott H. Thayer. In its extreme form as stated by these gentlemen, the doctrine seems to me to be pushed to such a fantastic extreme and to include such wild absurdities as to call for the application of common sense thereto. The Messrs. Thayer state their position in the most positive form. Fundamentally it is that, in the first place, all or practically all animals are concealingly colored, and in the next place, that while their patterns in all cases help thus to conceal them the chief factor in their concealment is the counter-gradation of shades, their inconspicuousness being due, not to their color being like that of the surrounding objects, but to this counter-gradation causing them to escape being seen at all. In order to show the sweeping claims made by the Messrs. Thayer, and accepted by their scientific followers, I quote their exact language:

"The discovery that patterns and utmost contrasts of color (not to speak of appendages) on animals make wholly for their obliteration, is a fatal blow to the various theories that these patterns exist mainly as nuptial dress, warning colors, mimicry devices, ... etc., since these are all attempts to explain the entirely false conception that such patterns make their wearers conspicuous. . . . The most gorgeous costumes being, in their own way, climaxes of obliterative coloring scarcely surpassed even by moths and inchworms." "The so-called nuptial colors, etc., are confined to situations where the same colors are to be found in the wearer's background, either at certain periods of his life or all the time. Apparently not one 'mimicry' mark, nor one 'warning color' or 'banner mark', nor one of Gadow's light-and-shadow-begotten marks, nor any 'sexually selective' color, exists anywhere in the world where there is not every reason to believe it is the very best conceivable device for the concealment of its wearer, either through the main part of this wearer's life, or under certain peculiarly important circumstances." "The colors, patterns, and appendages of animals are the most perfect imaginable effacers under the very circumstances wherein such effacement would most serve the wearer." "If creatures were purely and simply 'colored like their surroundings', they would not be inconspicuous at all." "What people commonly fail to perceive in connection with this matter, is that the exposition is really that of a discovery, i. e., of an indisputable optical fact, hitherto unnoticed, and not merely that of one more theory. It is a revelation of how animals' wonderful inconspicuousness in their normal haunts, recognized for centuries but in its essence never understood, is really achieved." "This counter-gradation of shades, from dark mid-backs to white mid-bellies, is. . . . precisely the system of coloration of almost all protectively colored animals." "The reader . . . . is now in a position to perceive the fallacy of the statement, prevalent in former years, and still made by certain writers, that a protectively colored

animal of the type described above escapes detection because, being of a dull brown color like the ground and the bushes, it looks when it sits motionless like a clod or a stump — or some such inanimate thing. For clods and stumps are solid objects of a uniform tint, and manifest to the eye, by the laws of light-and-shade, not only their solidity, but all their smaller modelings. They are not inconspicuous, except in so far as their great abundance makes the eye inattentive to individual ones. The protectively colored animal, on the other hand, is, as it were, obliterated by his counter-gradation of shades, and in the cases where he escapes notice, it is by virtue, not of the eye's perceiving his solid form, and taking it for that of an inanimate object, but of its failure to recognize it as a solid object of any kind, seeming, if it rests on it at all, to see through it to what is beyond." "All patterns and colors whatsoever of all animals that ever prey or are preyed upon are under certain normal circumstances obliterative." As an explanation of all this the authors say that they attribute it entirely "to natural selection, pure and simple and omnipotent."

Misstatements of Facts as set forth by them pictorially and in their Text.

Before discussing these positions and the arguments advanced on behalf of them by the Messrs. Thayer, I wish to call attention to certain arguments of theirs, both in the shape of pictures and in the shape of letter-press, which are really not arguments at all, properly so considered, but are simply misstatements of facts, or wild guesses put forward as facts. I do not for a moment suppose that the misstatements are intentional on the part of the Messrs. Thayer. I believe that they are due to the enthusiasm of a certain type of artistic temperament, an enthusiasm also known to certain types of scientific and business temperaments, and which when it manifests itself in business is as sure to bring the owner into trouble as if he were guilty of deliberate misconduct. For example, the Messrs. Thayer's endeavor is to show that every color and every pattern is obliterative, and among other things that colors fade into the sky. The frontispiece of the book is a picture of a peacock in a tree, with the blue sky showing through the leaves in just sufficient quantity here and there to warrant the author-artists explaining that the wonderful blue hues of the peacock's neck are obliterative because they make it fade into the sky. The peacock is accordingly portrayed under conditions under which he probably would not be seen once in a thousand times. (Incidentally, if the peacock was obliterated under such conditions, the peahen would be conspicuous, which of itself would destroy the Thayer's theory; but this is not the point to

which I am alluding at present.) In order to make their case, the Messrs. Thayer picture the blue neck of the peacock against a patch of *blue* sky, and of exactly the same color as the sky, and fading into it. But in figures 107 and 109, in the body of the book, they portray the white rump on the prongbuck as fading absolutely into the *white* of the sky.[1] Now no two colors could be more unlike than the deep brilliant blue of a peacock's neck and the dazzling white of a prongbuck's rump; and if one of these fades into the sky, then it is perfectly evident that the other is in sharpest contrast to it; yet when they make a picture of the peacock, the Messrs. Thayer make the sky the exact color of the peacock's blue neck, and when they give a picture of the prongbuck they make the sky the exact color of the antelope's white rump. If instead of being an artist, one of the Mr. Thayers were an engineer, and were employed by a business organization to investigate some proposition and report on it, and he based his report upon such action as this, he would be promptly dismissed from his position; and if the corporation tried to float shares on the strength of such a report, its directors would lay themselves open to a prosecution for fraud. Again, in figures 90 and 91, Mr. Thayer purports to show how a zebra is obliterated by its stripes. Accordingly he has one picture of a zebra without stripes, that is, of a wild ass, in reeds, and another picture of the zebra with its stripes in the reeds. Here (exactly as when he draws the peacock, he forgets the existence of the peahen) he forgets that there are just as many kinds of wild ass as of zebra, and that if his figures were true he would only succeed in proving that the zebra is obliteratively colored by proving that the wild ass is advertisingly colored, which would be equally fatal to his thesis. But, aside from this elementary fact, the point to which I now wish to draw attention is that he is utterly unable to be straightforward with himself in such figures; for in the picture of the unstriped zebra he is careful to make all the reeds criss-cross behind it so as to throw the figure out into relief, while with the striped zebra the reeds are in front as well as behind it, so that the effect is in no way parallel. On the same page with these two figures, by the way, there is also a figure of a chipmunk among dead leaves, to show that its stripes render it inconspicuous. The photograph is of no value anyhow, not giving any of the proper colors and improperly leveling the shades; but disregarding this, the elemental fact remains that even in the photograph the stripes do have a slightly advertising effect, and help one to find the chipmunk, for if it were colored as a meadow mouse or mole shrew is colored, without any stripes, it would be a

[1] As Mr. Thayer states that the white rump of the antelope is so colored to deceive animal foes that look *up* at it from below, he cannot mean that it is only seen against the lighter colored blue of the horizon sky.

little more difficult to see. The picture, however, like the majority of the pictures upon which the Messrs. Thayer most rely is of no value whatever from the standpoint of the serious truthseeker, and is of interest merely as are the puzzle pictures in Sunday newspapers.[1] Again, in figure 61, a chickadee is shown with its head against a dark hole, attention being called to the way the black head markings merge into the dark hole beyond. The chickadee is about to enter the hole. Now of course anyone who is willing to spend an hour in the woods almost anywhere can tell for himself, that this is a photograph of a chickadee in an exceptional position, in which the chickadee would never remain motionless for any time. At any given moment of a chickadee's career, even while it is breeding, the chances are a thousand to one, and probably much more, that it is not sitting motionless with its head against a black hole into which it intends to go, and on the nine hundred and ninety-nine other occasions the bold black and white markings of the head have a strong advertising instead of concealing quality. We think of a chickadee as inconspicuous only because it is small. Its coloration is so conspicuous as to strike the eye at once. If it were as big as a crow, it would probably be hardly as conspicuous as the ordinary wholly black crow, but it would be as conspicuous as the less, but still highly, conspicuous hooded crow of Europe. The chickadee is always on the move, and its coloration is so bold that it is probably safe to say that among our small birds it is the one of all others which practically never owes its escape from any foe to escaping observation. It certainly never owes its immunity from attack to any such combination of circumstances as that set forth in the picture in question, for when it prepares to enter its hole it of course first flies to the tree and then with very little delay enters the hole. The picture is an interesting picture in itself, but it is misleading and deceptive as illustrating Mr. Thayer's[2] thesis. The very next picture to this figure, for instance, shows a black and white oyster-catcher near its nest on rocky ground, the idea being that the "countershading" and "ruptive pattern" conceal the bird. In the first place they do not conceal the bird, the extremely bold black and white having a high advertising value; and in the next place, Mr. Thayer must be aware of the fact that a

---

[1] Compare it with serious photographs of animals not posed to prove a theory; compare it for instance with the photos of chipmunks on pp. 167, 169 and 180 in Warren's 'Mammals of Colorado.' Chipmunks are diurnal little animals, with a coloration which is revealing rather than concealing. I suppose I have seen fifty specimens this spring; for although infinitely less plentiful than meadow mice or deer mice, they care so much less for concealment and are so much more conspicuous, in habits even more than in coloration, that they are far more often seen. In fact chipmunks are the most conspicuous, and the most frequently seen of all small mammals of about their size; they trust for safety to their alertness, their agility, and their burrows.

[2] To avoid continually referring to the "Messrs. Thayer" I shall hereafter use the singular; especially as the book professes to describe "Abbott H. Thayer's discoveries."

species of oyster-catcher of the Pacific Slope is entirely black. If the "countershading" and "ruptive pattern" have any effect, on the Atlantic Coast or European forms, of the kind Mr. Thayer thinks, then, as the black oyster-catcher of the Pacific Slope lacks both, it must furnish a refutation of Mr. Thayer's thesis. As a matter of fact all the oyster-catchers, both the black and the pied forms, possess a brilliant and striking coloration which hardly ever has any concealing properties, and which, for once it conceals the birds, advertises their presence a thousand times; just as is the case with stilts and avocets, and to a slightly less degree with black-bellied and golden plover.

Mr. Thayer's figures include cases where the bird's coloration has a protective quality and cases where it has not. His colored pictures are for the most part completely misleading — and when I use so mild a term I use it merely because Mr. Thayer's intentions are good. His pictures of wood-duck drakes, for instance, are designed to show that these birds are very inconspicuous, and so they are portrayed with the wood drake swimming among water lily blossoms, floating lily-pads, brown sticks and the like, under circumstances that make the vivid coloring of the bird disappear. Yet not five minutes of reflection are necessary to show that these pictures cannot represent anything of value from the scientific standpoint, for the duck is always dull colored, without the extraordinary tints and patterns which Mr. Thayer says make the drake inconspicuous, and for some weeks after the breeding season the drake is colored like the duck. Now of course if the drake's brilliant normal coloring really tends to obliterate him, as Mr. Thayer says, then the dull color of the duck, and of the drake immediately after the breeding season, must, in precisely the same situations, tend to advertise them. Moreover, the black duck, or dusky duck, is found in the same situations, and if the wood drake's coloration tends to conceal him, then the black duck's coloration must tend to advertise and reveal him. As a matter of fact the circumstances under which the brilliant coloring of the wood drake tends to conceal him are wholly abnormal. So far as it has any effect at all, the normal coloration of the wood drake is of a highly advertising quality; but the conditions of life of the wood duck and of the dusky duck are such that, under most circumstances, the surroundings conceal them, *when they are concealed* (usually they are not concealed at all) without regard to their colors. Ordinarily, then, the coloration has little effect; but it is probable that the ducks of both species, and perhaps the drake of the dusky duck, do owe a certain small concealing effect at special times and under special conditions to their colors, whereas the drake of the wood duck, when in the nuptial dress, has what under ordinary conditions is certainly a highly advertising costume. Through-

out the greater part of the year the drake and the duck are in company, haunt the same places, and have the same habits; and it is of course self-evident, as their coloration patterns are so totally unlike, that under such circumstances both cannot be concealing; and to treat them as such is simply to juggle with words. During the moult, after the breeding season, when the sexes are colored alike, it may very well be that the drake does find his coloration concealing, precisely because it is so widely different from his ordinary (and strikingly revealing) coloration; this being the critical time of the year for him, the only time when he needs concealment. The ducklings, like the young of so many swimmers, waders, and game birds, do try to conceal themselves; and special study (in the field under natural conditions, not under utterly artificial conditions in a laboratory) may very well show that in such a case as this of the wood duck the young and the female, and even the adult male at certain seasons, are concealingly colored, although during most of the year the coloration of the adult male is revealing.

Very many of Mr. Thayer's pictures deliberately reverse the truth. The colored plates of the red spoonbills and flamingoes are worth attention. These are designed to show that the striking coloration of the birds in question — coloration which of course, as any man willing seriously to consider the question for a minute must realize, is normally highly advertising in quality — is really concealing. With singular innocence Mr. Thayer shows both white flamingoes and red flamingoes, on the theory that both of them fade into morning or evening sunlight. Of course if one color does, then the other color does not; and equally of course if these red and white birds are inconspicuous to their prey or to their foes, then the much more numerous black and gray and blue and brown and even yellow water birds, and birds of all kinds of tints which live in the same localities, must be conspicuous.[1] As a matter of fact, for once when, under any conceivable circumstances, the brilliant coloring of a flamingo or a spoonbill or a scarlet ibis tends to disguise it, there are probably ten thousand occasions, or many more, when this coloration is of the most highly advertising quality. Probably none of these colors has any effect one way or the other, as regards the creatures on which the bird preys; the red, white, black, blue, gray, brown

[1] The really wonderful mounted bird groups in the American Museum of Natural History will enable anyone to realize the truth of this at a glance; or let any inquirer turn to the letterpress and photographs — almost equally valuable — in Mr. Chapman's delightful 'Camps and Cruises,' especially the chapters in which he deals with flamingoes, herons, pelicans, skimmers (the young of which, by the way, apparently really do possess concealing coloration and by their conduct in crouching on the sand give it its full value while the strikingly colored adults are very wary and show by their conduct their knowledge that they cannot escape observation); or consult the capital volumes of Herbert K. Job and William L. Finley.

and mottled and diversified wading birds being apparently equally successful in obtaining their food and avoiding their foes.

Among Mr. Thayer's utterly misleading pictures, is his picture of blue jays. He actually pictures the blue jay in winter, in blue shadow on snow, to show that the blue shadow on the snow is of precisely the same color as a blue jay. The shadow is painted so blue that until I read the text I had no idea that it was not a pool of blue water, and it is painted exactly the color of the blue jay's plumage. This winter I carefully studied the blue jays in my neighborhood. The enormous majority of the shadows, in fact all that I saw during the winter, were not blue shadows of the color of a blue jay's plumage; and if they had been, while they might have harmonized with the blue jay, they would have been out of harmony with every other winter bird, with the far more numerous snow birds, for instance, and the fox sparrows and tree sparrows. Moreover, whenever the jay was actually on the snow-covered ground, it was always conspicuous, whether it was in light or shadow; and it knew it was conspicuous, and, on the most distant approach of danger, flew into a tree. It trusted for concealment to keeping among the branches and slipping out on the opposite side of the tree when anyone approached. Here again it ought not to be necessary to say that it is a simple impossibility that the blue jay's coloration can have been developed in order to make the bird invisible under the almost never-occurring conditions when it happens to strike a small patch of shadow on the snow which is of the same bright blue color as its own bright plumage. Moreover the utter folly of such a theory is evident at once to any one who remembers that the species of blue jay in question dwells largely, and many other species of blue jay dwell wholly in regions where snow never falls.

Mr. Thayer's book includes 251 pages. It is impossible to go over page by page the really countless erroneous statements, wild guesses, and absurd interpretations of facts, which the book contains. Some of the pictures help to illustrate truths; others, both paintings and photographs, are elaborately designed to perpetuate glaring error. The same is true of the text. I regret to state that I do not think I know of a professedly serious writer whose text contains a greater number of absolutely misleading statements. I have no question that Mr. Thayer intends to put his facts honestly; but in actual practice he is evidently unable to study facts with the sincere desire of finding out what they are, and of making proper deductions from them. He not merely twists his facts to suit his theory, but in almost every case rejects, alters and rearranges them so as to make them fit into the theory even when, if frankly faced, they prove the direct reverse of what he assumes they prove. Notable examples of this are found in his treatment of zebras, skunks, and flamingoes; but these are only examples. The great majority

of birds and mammals he discusses are treated with the same, not merely disregard but inversion, of the truth, and this in small things as well as in great things. For example — I am choosing almost at random — when he deals with jacanas, he actually speaks of the spurs on the wings of these diminutive birds as being for defence against alligators, tortoises and other foes! Now few things are absolutely impossible, outside of the domain of pure mathematics, but if a jacana can use a wing spur as a defence against an alligator or a big carnivorous snapping-turtle, then the event is so extraordinary that some attempt at proof should be submitted. It would be a feat much like using a pen knife against a thirty-foot shark. Yet this utterly wild suggestion is advanced without one particle of substantiation by Mr. Thayer.

A couple of pages beyond he says that certain minute horizontal flank markings on various ducks are "ripple pictures," and that these ripple pictures on ducks like the old-squaw, hooded merganser, and red-breasted merganser, disguise the swimming bird and make the eye think that there is nothing there but water. Here again there is no argument to make; all that can be said is that the explanation is preposterous. The hooded merganser, the red-breasted merganser and the old-squaw are birds of extraordinarily conspicuous coloration. The minute patterns in question could not be seen by any eye, and could not "merge" the bird into ripples, unless the observer were within a few yards; and as a matter of fact, if his eyes were worth anything, the duck would have been plainly visible a quarter of a mile or half a mile or a mile away so that the minute "ripple pictures" could never be seen by any foe that had not already, for a substantial period of time, been engaged in observing the duck. All that Mr. Thayer says about the effect of the "vermiculation" of pattern on ducks, and of most of their markings, and indeed nine tenths of what he says about these finer patterns everywhere, is subject to just the same criticism. The minute patterns could not be seen at all until the foe was so close that it would be absolutely impossible for him not long before to have seen, and made out, the wearer.

Again, take the whole chapter on the "masking" of the bill and feet of hawks and predacious birds. Mr. Thayer actually thinks that the feathers around the legs of hawks blur "the deadly feet," and so reduce the victim's chance of successful dodging, and he asserts that the fact that the bare feet of hawks are usually light in color must have a deceptive effect "inasmuch as pale bright colors are less characteristic of hard animal substances than of leaves and flowers and grasses"! Of course, in the first place, when hawks pounce, they do it with such inconceivable rapidity that the victim would be totally unable to differentiate in any way among

the minor points of the pattern. In the next place, the victim is hardly ever fighting; it is fleeing, and it does not try to dodge the claws, it tries to dodge the whole bird. In the third place, owls, which strike their prey in darkness and where the animals preyed on cannot possibly see the bird's pattern of coloration, nevertheless have their feet more heavily feathered than hawks. As to the supposition that animals think the feet of hawks are harmless because they are light-colored — really one ought not to be called upon to discuss it. Mr. Thayer's theory about the deceptive effect of the feathered and light-colored legs of hawks, and of the coloring on and about the bills and feet of predacious birds generally, stand on an exact par with a theory which would assert that the lion has a mane in order to distract the attention of his prey from his teeth, and that his teeth and claws are light-colored so that the prey may think that they are soft.

Again, all that Mr. Thayer says about hummingbirds comes in the same category. He actually states that hummingbirds' metallic colors mark the climax of the "high obliterative power of iridescence" and that they have "an almost unrivalled obliterative equipment," and that this obliterative equipment keeps them from the sight of insects lurking among leaves and flowers. What possible way is there of meeting an argument so absurd? Of course if Mr. Thayer's theory were true, instead of self-evidently false, it would mean that the females were not obliteratively colored, that they were not as well equipped to get insects as the males — in itself an unsupposable proposition. In the next place, any effort to prove that the colors of male hummingbirds, and their appendages, are obliterative, stands on an exact par with the statement that a peony or a tulip is obliteratively colored, and is less conspicuous than a violet or a mayflower. If male hummingbirds, because of their appendages and iridescence, are protectively colored, then tulips, peonies and poppies are all inconspicuous and difficult of observation, and far harder to see than violets. The proposition is no more absurd in one case than another, and the mere fact that Mr. Thayer can make such a proposition shows that he has worked himself into such a frame of mind that no single unsupported statement he makes ought to be accepted as needing serious study. He does not advance one fact to justify any one of these positions. They are pure wild guesses; and in what purports to be a serious study of animals they make his book rank with a book on botany which was predicated upon the statement that tiger lilies and sunflowers are much less conspicuous than the tiniest flowers found under the dead leaves in the woods. I mention these cases, be it remembered, merely as examples. From cover to cover his book is filled with just such perversions of fact and such wild guesses masquerading as facts. I could give hundreds of quotations showing positions just as wild and foolish as those I have above mentioned.

One of the difficulties to which Mr. Thayer pays no heed is that if his arguments are true as to certain birds, they thereby at once become false as to other birds. He says, for instance, that the "cormorant's green gloss in the water, looked up at from deeper down, proves to be a perfect match for the translucent water itself." But young cormorants lack the gloss, while loons, grebes, auks and murres are white beneath. If an adult cormorant is a perfect match for the translucent water when seen from below, then the other birds offer a striking contrast to the water. It is possible to argue that one type of coloration is concealing only on the ground that the other is revealing or advertising. This applies to Mr. Thayer's whole argument as to the concealing or obliterative effect of iridescence. If the iridescent male anhinga becomes concealingly or obliteratively colored because of its iridescence, then the lustreless female is revealingly colored. It is possible (and in this case it is the fact) that both birds are advertisingly colored, merely because they are so dark; but it is not possible that both the iridescence and the lack of iridescence, are concealing; it is not possible that iridescence renders certain species, or the males of certain species, obliteratively colored, and that at the same time the lack of iridescence in other species with the same habits, or in the females of the same species, also renders them obliteratively colored. As a matter of fact, of course, iridescence is practically never obliterative; an iridescent bird is under normal conditions almost always of a somewhat more advertising quality than a lustreless bird. Again, Mr. Thayer says that the fact that the scarlet tanager's coloration "divides it into two things, a black and a red thing," shows that it is not "meant to be conspicuous" because in that case it would be "monocrome." But the summer red-bird and the cardinal are both monochrome! Mr. Thayer simply forgets this, and forgets that the argument he advances to show that one is inconspicuous, necessarily shows that the two others are conspicuous. As a matter of fact, of course the plumage of all three birds is highly advertising.

It is possible to meet such statements as these with arguments; but many of Mr. Thayer's assertions it is only possible to answer by saying that they are not so. He says, for instance, "the crow's rainbow sheens, so little thought of as concealers, turn him into such true distance colors as he sits on the nest, as to rank him at this moment almost with the grouse for indistinguishability." Here there is no more chance for an argument than if Mr. Thayer said that a wistaria vine in full bloom, or a mass of purple bourganvillia flowers on the side of a house, was inconspicuous, or that a coal scuttle planted in the middle of a green lawn was inconspicuous. Under all normal conditions a crow's coloration, and the coloration of

ravens, magpies, most jays, all grackles, cowbuntings, and blackbirds and most orioles, is highly advertising. A crow is a very conspicuous bird, on its nest and off its nest, on the ground and in the air, in the forest and in the field. There is no time of its life when its coloration is concealing; its safety is due to its wariness, astuteness and bodily vigor. The fact that Mr. Thayer's eye and brain make him regard a crow on its nest as having concealing color, in the same sense that a grouse has concealing color when on its nest, merely shows that his comments are of interest chiefly from a subjective and not an objective standpoint, that he has permitted himself to become obsessed by his subject.

Mr. Thayer's book is for the most part filled with theories predicated upon observations made under conditions which are designedly abnormal. Any practical expert with colors knows that extraordinary effects can be wrought by a proper arrangement of lights and shadows. If seen against the horizon under certain conditions of light, all animals, no matter what their real color, will seem to be of the same color; and no color can be imagined which will not become inconspicuous, whether on an animal or off an animal, if against certain backgrounds. Mr. Thayer's experiments in concealing animals by the proper use of light and shade, and by putting them against the right type of background, ought to be of value to the large number of people who apparently have no idea what a landscape in nature really is, and who do not understand the extraordinary play of light and shadow, and the variety of color effects, to be found in any forest landscape, especially among the tree tops. But they are of very little value to anyone who has passed this elementary stage; and they are of worse than no value when the conditions arranged are abnormal, and yet are painted or described as normal.[1] The raven's coloration is of course concealing if it is put into a coal scuttle; and if chalk is added to the contents of the coal scuttle, then a magpie's coloration might also become concealing under the same circumstances. Now much of Mr. Thayer's work is predicated on experiments which stand on a par with putting a raven or a magpie into a coal scuttle in order to show that its coloration is concealing.

The Rôle of Countershading.

So much for the arguments by which Mr. Thayer sustains his positions. Now for a discussion of the positions themselves, as I quoted them at the outset of this writing. Reading those quotations, it will be seen that he

[1] Since writing this paper I have seen the excellent review of Mr. Thayer's book by Messrs. Barbour and Phillips in 'The Auk.' These gentlemen rightly say: "By skilful jugglings we are shown how anything and everything may be rendered inconspicuous, usually by artificial means, or under artificial conditions. . . . This method of persuasion, while it does appeal to the public, is — there is no other word — simply charlatanry however unwitting."

claims that the counter-gradation of shades from dark mid-back to white mid-belly is the essence of concealing coloration, and not the likeness of the animal's color to its surroundings; and that all patterns, no matter how vivid and contrasting, make wholly for the obliteration of their wearers; that all gorgeous costumes have the same effect; that the "so-called" nuptial colors, mimicry marks, warning colors, and sexually selective colors are everywhere in the world the best conceivable devices for the concealment of the wearers, and the most perfect imaginable effacers under the very circumstances wherein such effacement is essential; and that finally "all patterns and colors whatsoever of all animals that ever prey or are ever preyed upon are under certain normal circumstances obliterative."

Stated in this sweeping form again and again, and with continued reasservation, Mr. Thayer's theory is absolutely false. It must be remembered that this theory is not at all that some patterns and some colors are concealing, that some animals are concealed by their coloration, facts which have long been known and universally admitted; his theory is that *all* patterns and *all* colors of *all* animals are concealing, and that the prime factor in the concealment is the countershading, with as secondary factors such pattern schemes as very bold and sharp contrasts between masses of color on the same animal. It is this theory thus sweepingly advanced which is absolutely false. Almost without exception nuptial colors and appendages occur in situations where the same colors are *not* commonly to be found in the wearer's background. Bold patterns and utmost contrasts of color in the majority of cases *do* tend to make their wearers conspicuous, and tell markedly against concealing them. Ordinarily, so-called mimicry marks and warning colors, and sexually selective colors, are usually not only *not* the best conceivable devices for the concealment of the wearer, but devices which, consciously or unconsciously, effectively advertise such wearer. Animals are most inconspicuous when they are purely and simply colored like their surroundings. The counter-gradation of shades from a black or very dark mid-back to a white mid-belly is hardly ever protective; and a protectively colored animal usually escapes detection precisely because it *is* colored like the ground or the bushes and sits motionless like a clod or a stump, amid such surroundings that the eye overlooks it because of the great abundance of the inanimate objects around about. Upon the great majority of animals that prey or are preyed upon there are some patterns or colors which under some normal circumstances are advertising, and as regards many animals all their patterns and colors whatsoever are never under any normal circumstances obliterative but always advertising. In other words, with one exception every single new proposition advanced by Mr. Thayer is contrary to the actual fact, and the only new proposition he advances which has any real merit, that regarding

counter-gradation, although important as a coloristic law, has a very limited application among birds and mammals so far as concealing them is concerned and is false in the extreme form in which he states it.

Concealment due Mainly to Cover and Habits.

In order that the real facts may be understood it is necessary to keep certain propositions clearly in mind.

Wherever the conditions are such that any object, no matter what its color, is difficult to see, it is a misuse of words to speak of all colors as concealing. The fact simply is that under such circumstances no color has much or any value, either concealing or advertising. In most forests, for instance, especially among the higher branches, there is an infinite variety of colors, of lights and shades, of distances and vistas, and an infinite number of individual objects, leaves, twigs, branches, excrescences on branches, and, on the ground, logs, sticks, heaps of earth, little gullies, stones, mosses, ferns, etc. etc. If the forest is sufficiently rich and the colors in it sufficiently varied, as in some tropical forests, the result is that any small bird or mammal of any color becomes very difficult to see. But this does not mean that the colors are concealing; it means merely that the surroundings are such that the advertising or concealing quality of any color is reduced to the minimum. In a dense tropical forest, as I know by actual experience, huge beasts like elephants, buffalo and rhinoceros, in spite of their size and their conspicuous uniform coloration, may be difficult to make out at any distance in the mass of gloom, in the occasional lights, and amid protecting tree trunks, vines and ground jungle. Very keen eyes, whether those of a savage or a wild beast, will see such animals much quicker than the white man's eyes. I have spent nearly a minute in endeavoring to make out an elephant much less than a hundred yards off which my native companion saw at once; but under such circumstances it would be absurd to speak of the elephant, or the rhinoceros, or the buffalo, as being protectively colored. The fact is simply that the surroundings are such that no coloration has very much effect one way or the other. What is true of these giant creatures is of course infinitely more true of small birds and mammals. If black squirrels, white-bellied squirrels, orange-bellied squirrels, gray squirrels, brilliant red male tanagers, dull green female tanagers, warblers of all conceivable colors, and nearly uniformly-colored vireos, are almost equally difficult to see among the tree tops, it means, not that every kind of coloration is concealing, which would be nonsense, but that the conditions are such that any small mammal or bird which remains motionless is difficult to see, and that its coloration is of little or no account. Again, the difference made by

the mere element of size must continually be taken into account. On the plains of Africa a cock ostrich is at once recognized as a most conspicuous bird because of its size and coloring. But disregarding the element of size, the bobolink and lark bunting are just as conspicuous as the ostrich. No man in his senses would speak of a cock ostrich as being protectively colored under any normal conditions; but it is precisely as great an error to speak of the cock bobolink or the cock lark bunting as being protectively colored. Nobody seriously pretends that the raven is protectively colored; but it is exactly as protectively colored as the cow bunting. The only difference is that the cow bunting is small and the raven big. A blackburnian warbler the size of a turkey would be regarded as a marvel of advertising coloration; being a small bird, it is difficult to see, merely as a turkey would be difficult to see if it lived in the tops of sequoia trees. In picturing to ourselves the way that small birds and mammals look to the small birds and mammals that prey upon them, we should continually think how big birds and big mammals appear in our own eyes.

Now as to the insistence Mr. Thayer puts on some of his propositions. When he says that "the striking patterns" and "the utmost contrasts of color" on animals "make wholly for their obliteration," really the only way of answering him is by a negative. The red-headed woodpecker exactly fulfills Mr. Thayer's description of an animal with such a pattern and contrast of color. If in Mr. Thayer's eyes a red-headed woodpecker in its normal surroundings is inconspicuous there is no more to be said than we would say to a man who asserted that a large house standing alone on the prairie and colored half black and half white, with a bright red roof, was inconspicuous. The assertion is of interest from the standpoint only of an oculist interested in the observer's eyes. The red-headed woodpecker is one of the most conspicuous of all animate objects. Its habits are such that even a city-bred man must see this. There are innumerable examples of birds and animals as conspicuous, because of brilliant coloration, or because of their appendages, or because of being colored all one noticeable color, or with sharp contrasts of noticeable colors. Skunks, prongbucks, zebras, white goats, ravens, flamingoes, scissor-tailed flycatchers, yellow-headed blackbirds, bobolinks, white egrets are among such animals. There are immense families of birds, hummingbirds for instance, sun-birds, bee-eaters, where there are hundreds of species each of which possesses a coloration and appendages of a highly advertising value, and few or none which possess a coloration which is under normal circumstances of value to the bird for concealing purpose. As regards these numerous birds and mammals, it is hard to imagine how even the most careless or untrained observer can fail to note the advertising quality of their coloration. But as regards

the great majority of animals, we must remember that to the untrained eyes of civilized man they often appear inconspicuous, or as concealingly colored, when in the eyes of a savage hunter or a beast or bird of prey they do not seem inconspicuous at all. An ordinary man, even an ordinary scientific man of the closet variety, who is only acquainted with a zebra or a tanager in a museum, when he visits the wilds unconsciously expects to see the creatures loom up as conspicuously as in show cases; just exactly as a city man when first out after deer cannot even see a buck when it is pointed out. In consequence, instead of realizing that it is his own vision and attitude of mind which are at fault, he thinks that there is some peculiar attribute of invisibility in the animal itself.

Mr. Thayer says that nuptial colors are confined to situations where the same color is to be found in the wearer's background. Let him look out of his window, as I am looking at the Baltimore oriole in the elm, stroll down to his garden and see the orchard oriole in the cherry tree, or look at the red-winged blackbird sitting on a treetop beside the wet meadow, or at the bobolink in the pasture — the males of these four common birds each has a nuptial plumage (permanent or seasonal) with which there is nothing whatever in its normal background to correspond. For once that at any moment any one of these birds while in nuptial dress does find such a background there must be a thousand or ten thousand cases when the reverse is true. These are conspicuous birds, living where it is easy to observe them; but exactly the same thing is true of the hundreds of less conspicuous birds living as recluses round about us. It is true of almost all the warblers, for instance, of which so many species are to be found in our neighborhood, but which as a whole are such inconspicuous little birds.

Again, take what Mr. Thayer says of countershading, and of why a protectively colored animal escapes detection. Mr. Thayer insists that the animal escapes observation, not because its colors match its surroundings, or because it sits motionless like a stump, or clod, or some such inanimate thing, but purely because of its shading, which he says is rendered obliterative by the counter-gradation of shades, so that the eye does not recognize it as a solid object of any kind. That this is not so is proved by the simple fact that on an absolutely flat even surface no animal, whether countershaded or not, escapes notice. On a perfectly smooth lawn of very short grass a rabbit can be seen at a very long distance; on the great plains, as Mr. Hornaday has said, a jack rabbit looms up like a deer. On the flat, bare tennis court I can at once make out even a shrew or a mouse if as sometimes happens one of these little creatures strays there. The countershading is of no value in either case simply because there is no cover, no surrounding objects. Save in wholly exceptional cases, the countershading

by itself does *not* obliterate the animal; it does not render the eye apt to fail to recognize it as a solid object of some kind. The two prime features in enabling a dull-colored rabbit or mouse or other small animal to escape notice are, the likeness of the creature's coat in color to some of the surroundings, and the fact that it sits motionless among clods, stones, sticks and other inanimate objects so that the eye picks it out with difficulty from among them. In other words, the facts are the direct reverse of what they are as stated by Mr. Thayer. A muddy tennis ball in a ploughed field or among the dead leaves of a wood, or even in grass, is about as inconspicuous as a meadow mouse; the dull colors in one case harmonize with the surroundings just about as they do in the other. Often in the Rockies I have searched in vain to place woodchucks or pikas which I could hear whistling or squeaking, and finally I would see them only when what I had supposed to be a lump of earth or rock among other lumps of earth or rock move off. But I never found any difficulty in seeing either when I could get it on an entirely smooth surface of rock or ground, unless the color of the surface happened to agree absolutely with the color of the coat. I have already spoken of a rabbit's conspicuousness when on a flat level of short grass. It is difficult to see in long grass, or among tufts of grass, and still more in a wood, just because it is colored like some of the surroundings, and, more especially because the abundance of inanimate objects round about makes it hard to pick out. If it is sitting stern on its countershading practically vanishes for the rump, which is pressed against the ground, is as dark as the fore part or middle part of the back which is slightly raised; yet it is no more easy to make out in this position than if sideways to the observer. This alone shows how slight is the part that countershading plays in concealment, and it represents the results of observations that any one can make if he will look at the rabbits in the woods and fields of his own neighborhood, as I have been looking at them this spring. I have observed dozens of wild rabbits during the last few months. In short grass they are conspicuous, the countershading having no effect whatever, and the brown coat being sharply relieved against the green background. In long grass or thick shrubbery they are exceedingly difficult to see, not in the least because of their coloration, but because of their habit of crouching motionless, and because the cover physically screens them from vision. In the woods or in open undergrowth they are difficult to see (but not impossible to see), because their coloration is dull in tint, not vivid, and in general harmony with the dead leaves, twigs and shadows, and because the light is not bright, or if it is bright there is much play of light and shadow, and because there are so many varying vistas and obstacles and such countless irregularities and projections in the surroundings. If in such cases the

rabbit is sitting sideways to the observer the countershading may possibly play a very small part in helping to make it inconspicuous by rendering the lower outline dim; but I am not sure that even so much as this is true, because, as I have said above, a rabbit sitting with its stern towards the observer, loses all effect of countershading and yet seems just as difficult to make out. This spring, once or twice after heavy rain I have seen meadow mice in unusually open spots where I could examine them having in view this matter of concealing coloration. When they move they are visible at once; when they are still they always crouch nearly flat — their short legs render this necessary — and there is then practically no effect of countershading; it is a negligible element in concealing them; they are concealed because their dull colors, round contours, and absolute immobility make them look like lumps of mud, or other natural objects so that the eye fails to distinguish them from their surroundings, as one fails to distinguish a muddy tennis ball. On an absolutely flat and bare surface they are seen at once. Strolling through the woods this spring, birds such as the redstarts, black and white creepers, and yellow-throats were seen at once, the "countershading" on them not having the slightest effect, because the colors themselves (black, white, yellow, orange red) were so vivid; and the dull colored birds that tried to escape notice always crouched so low that the effect of the countershading practically vanished, and it was merely the general dull tint of the upper parts, together with the screen of the cover, and the varied surroundings, that enabled them, thanks to their habit of crouching motionless, to have a fair chance of escaping observation. All of these birds and mammals were observed under natural, not unnatural, conditions, at the time when, if ever, their coloration patterns and countershading would have been of use in concealing them.

The countershading, therefore, plays a wholly minor and inconsiderable part (usually an entirely negligible part) in the concealment of animals under such conditions. It does, however, I believe, play a certain small part, in some cases, even with birds and mammals, and very possibly a far greater part with lower forms of life; and Mr. Thayer is entitled to full credit for calling attention to this fact. Unfortunately as regards mammals and birds, he has given it a thousand-fold more importance than that to which it is entitled. The first consideration to be remembered in connection with countershading as regards birds and mammals is that it is of no value whatever to the animal unless the general tint is in harmony with some of the surroundings (and unless the ground is sufficiently accidented to confuse the eye of the observer and cause difficulty in picking out the living creature from among the inanimate surroundings). A dark-brown

countershaded animal in a green meadow or on a gray desert is practically as conspicuous as if it were not countershaded at all. Moreover, the countershading avails nothing for protection if the actual color above is black or the actual color below white, or if the pattern of the coloration is vivid.

As I have said again and again, but as I suppose I had better repeat in order to prevent all chance of misunderstanding or of misrepresentation, there is no conceivable color or combination of colors which may not under some exceptional circumstances be concealing. A British grenadier in a red coat and a bearskin hat might find himself, in some fight in a village, surrounded for a moment by red and black objects — red petticoats and black skirts on a wash-line for instance — which would make his coloration-scheme protective; and really it would be no more absurd to speak of the grenadier's uniform as therefore of a concealing character than it is for Mr. Thayer to speak of the red-winged blackbird's coloration as concealing, because it is possible that a hawk sailing overhead may on very rare occasions,— on an infinitesimal number of occasions,— see him against a background of black mud; or to speak of red crossbills and pine grosbeaks as protectively colored because, as he says, in northern winter landscapes the chief colors are "black," "white," "blue," "gray," "green," "golden-brown," "red," "purple" and "vinous ash." (In the first place, of course if all these colors are concealing, then it is quite impossible to imagine any color or combination of colors that shall not be concealing; and in the next place, if the red males of the grosbeaks and crossbills are concealingly colored, then their dull colored mates are not.) There are exceptional circumstances in which a white belly or a black back may be concealing; although hardly any circumstances in which both a white belly and a black back can be concealing. Normally both are advertising for all animals under all conditions where they can be seen at all. Multitudes of small shrews and mice (and outside of Australia ninety-nine per cent of the aggregate of individual mammals are shrews or mice) have brilliant white under parts. Where, as in many species, this white extends up the sides, as in the case of the pouched kangaroo rats, it has a certain advertising effect, or at least would have were it not for the fact that the great majority of these species are either nocturnal or else live in cover so completely protecting or concealing that their coloration is of no consequence. Where the color is simply on the belly, it does not advertise the animal, merely because it is not seen; that is, instead of this coloration concealing the animal, the animal conceals the coloration, and it has no effect one way or the other. It is safe to say that, whatever may be the causes that have produced the predominance of white on the bellies and underparts of so many mammals and birds, these causes have had nothing to do with the production of a concealing coloration.

It is hard to figure to ourselves just the effect that the coloration of mice or shrews has upon the small mammals that may see them from one side — the birds of prey, of course, see them from above, so that white cannot affect these birds one way or the other. Perhaps we can gain an idea by thinking of the effect that large black and white animals have upon our own eyes. The sable antelope of Africa is colored black and white, and it is one of the most conspicuous animals in the entire African fauna. An absolutely black coloration is itself so conspicuous that I hesitate about using a comparative or superlative in connection with it; but if there is anything more conspicuous it is an absolutely black animal with the black relieved by a snow-white belly of which the color extends a short distance up on the sides. The sable antelope of East Africa, however, at noon retires into thick cover to lie down. It is then hidden from the sight of its foes simply because the cover is so thick that its highly advertising coloration becomes of no consequence, and it cannot be hunted with much chance of success. When on the plains in the morning and evening it can be seen at once and makes not the slightest effort to try to evade being seen, simply endeavoring to watch for any foe. The black or blackish old bucks of the white-eared kob are substantially, for their size, as conspicuous as the sable, and are also beasts of the open. As I shall hereafter show, these big antelopes of the plains owe nothing to concealing coloration, any more than buffalo, elephant and rhino do. On a great plain covered with grass two or three feet high every zebra, wildebeest, topi, kongoni, eland, Grant's gazelle or oryx, within range of vision, will be seen at once, as the animals have no idea of hiding, and stand very erect. Yet a lion on such a plain would probably not be seen at all, and a leopard would almost certainly escape observation: and neither of them, even if accidentally seen, could be hunted with any chance of success, simply because each would skulk away under cover of the grass. Their coloration is no more protective than that of the eland or oryx or the big gazelle bucks, and if their habits were like those of the antelope they would be just as conspicuous. It is the difference in habit and in desire and ability to take advantage of cover and not the difference in coloration which under such circumstances make the lion and leopard so very difficult to see under exactly the same conditions which make it impossible for the big antelope to escape observation. Moreover we must always remember that if there is any cover any animal that stays still may escape observation; and if in sufficiently thick cover will in all probability escape observation. In reeds, elephant grass, papyrus and thick jungle, elephant, rhino and buffalo will often stand motionless when they suspect a hunter is following them; and then, in spite of their bulk and of what even Mr. Thayer admits to be their advertising coloration, that is, the dark monochrome of their huge bodies,

they cannot be seen until they are stumbled upon at a short distance; a fact so self evident to every hunter that the danger of following these animals in such cover is proverbial. In short, wherever the cover is at all thick, it is the cover itself and the ability to take advantage of it — in other words the animal's habit of life — that count infinitely more than the coloration; and in the coloration it is the general tint and its harmony with the surroundings that count, infinitely more than the countershading can possibly count. This is more readily seen by us to be true in the case of big mammals and birds, because we can study these with ease from the standpoint of their natural foes or their natural prey; but the facts are fundamentally the same as regards mice and sparrows and as regards antelope and ostriches. These facts ought to be self evident: but if anyone doubts them let him remember the occasions when he has lost a pipe or a penknife in a meadow or a forest, or even on a plain of short grass. The pipe is not countershaded, and the penknife is probably advertisingly colored, and yet an indefinite search may be necessary before either is discovered.

The white or yellow breasts of birds are generally advertising and are generally concealed by the birds crouching as soon as they suspect danger or desire to escape observation. If a wood thrush is sitting facing toward the observer, it is apt to be seen a little more quickly than if it has its back toward him. But the prime need for observers to keep in mind when watching the creatures of the forest, or the creatures of the grass which habitually appear below and not above the level of the grass tops, is that not only does the cover serve as a physical screen, but that by its infinite variety it makes it easy for anything motionless to escape observation. There are in a forest, whether among the branches or on the ground underneath, a myriad lights and shadows, shades of color, vistas of infinitely varied length, and material objects of almost every conceivable shape and size; and in such a wealth of varying detail it is very difficult for the eye to pick out any single motionless object whatever its color. In the grass the same is true to a less extent, and the less variety in, is counter-balanced by the greater thickness, and therefore greater screen effect of, the cover.

It thus appears that the coloration very rarely has a concealing effect unless it is assisted by cover and is in harmony with the surroundings; and that as regards the majority of birds and mammals that seek to conceal themselves cover is a far more important element than coloration, although sometimes coloration is also important. Certain species of mammals and birds, including nighthawks, and many grouse, snipe and desert birds, are concealed by their coloration without regard to cover and show by their actions their ability to take advantage of their concealing coloration; but

cover is generally the vital element. As far as countershading is concerned, it has no obliterative effect whatever if the pattern is of conspicuous colors; a bird colored black or red or blue above and white or yellow or reddish brown below may be countershaded, but it is certainly not obliteratively colored. The countershading can be of assistance only when there is a gradual fading from a neutral tint above to a lighter neutral tint below, and when these tints are in substantial harmony with the colors of the landscape. Keep in mind always that movement tends to reveal any animal, no matter how it is colored; coloration conceals chiefly when the wearer is motionless. The habits of a bird or mammal must always be considered before saying whether its coloration is or is not concealing; an animal which possesses a really concealing coloration almost always acts in a manner which will make it useful — as a nighthawk acts when sitting in a field or on a roof in the day time. When a bird behaves as a robin or oriole, for instance, behaves, it indicates that its coloration is not concealing.

To those who think that countershading in the animal world is due to natural selection working in every instance for the production of a concealing coloration I would call attention to the vegetable world. The commonest of all vegetable productions are leaves. They exist in myriads everywhere; and almost all of them are colored dark above and light below. The same thing is true of multitudes of flowers, and of most fruits. In a note recently received from John Burroughs on this subject he says: "Why, pumpkins and melons and apples and peaches are lighter underneath, no doubt with a view to protection from the boys!" The principle of natural selection working toward a concealing coloring is certainly not responsible for what is seen in the plant world, and it may be but little more responsible for what is seen in the animal world. In so far as countershading is, for this purpose, held merely to mean a lightening of neutral tint from above downwards, without violent breaks, it is possible to argue that it has been produced by natural selection working towards the production of a concealing coloration — at least such a position may be defensible (although I am not personally convinced that it is true as a general rule, so far as mammals and birds are concerned). But it is quite impossible that any such cause can have produced the white bellies of animals, which are no more protective or concealing to their owners than are the light under-surfaces of leaves to the leaves. As most animals that rely for defense upon their coloration crouch motionless in order to escape observation, thereby reducing the countershading to a minimum, and as many animals that are not countershaded at all, such as wolverines, fishers and minks, are just as successful in life as others that are countershaded, it follows that Mr. Thayer's prin-

ciple of countershading as a prime factor in helping the wearer by concealing it, cannot apply universally: and it is quite possible that it does not apply at all; personally I am inclined to think that among birds and mammals it may sometimes apply, but only in a very limited number of cases. If we consider the colors of tree trunks, we shall be better prepared to understand that differences of colors in birds and mammals may come in part from causes for which we are at present entirely unable to account. A cinnamon sequoia, a red manzanita, a white birch, a spotted sycamore, a gray beech, a black oak, a white oak, have trunks and stems as differently colored as are the bodies of most birds or most mammals; and the rarity of brilliant bird-hues in mammals may have no more to do with concealing coloration than the rarity of black in tulips.

Above, in commenting on the fact that its small size renders it hard for us to discern the color of a small bird at any distance, or even to distinguish it readily, no matter what its color, when in varied or fairly thick cover, I took the cock ostrich as illustrating, by the way it appears in our eyes, the way in which ordinary birds appear to other birds, or small mammals. The ostrich looms as large to us as a grouse or gallinule to a weasel or mink. The lion, and occasionally the leopard, are foes of the old birds; hyænas, jackals, wildcats, eagles and vultures prey on the chicks or eggs. The cock ostrich, with his black coloration, varied by white, is one of the most conspicuous of living creatures. In the African landscape I found that I could see a cock ostrich farther than any other game except the elephant and giraffe, and possibly the rhinoceros. The hen is neutral tinted. She is visible only at a far shorter distance than the cock; and relatively to him she is concealingly colored. Nevertheless this concealing coloration is of absolutely no advantage to her in her ordinary life. She cannot be seen as far as the cock, but she can be seen at such a distance as to expose her to the attack of any enemy that would attack the cock, and neither of them makes any effort to hide, trusting purely to eyesight, wariness and speed for safety. Both parents lead about the chicks, which run freely as soon as they leave the egg; so that the hen gains nothing from her concealing coloration at this time, and the chicks gain nothing from it. There remains only the period covered by the actual brooding of the eggs. If the hen alone brooded the eggs, it could be said that she was concealingly colored to defend her while performing this vital function. But the cock and the hen brood alternately, and I could never find that his advertising, and her concealing, coloration made any difference as far as discovering the nest was concerned. I have seen it stated that the cock only broods by night; but in observing wild ostriches in East Africa I found the cock on the nest in the daytime as often as the hen. The bird sits on the eggs with its neck out-

stretched on the ground in front of it. The nest — if such it can be called — is placed where bushes and patches of grass are scattered around, so as to screen the bird from the sight of passing creatures unless they come very near. According to my experience hen and cock lie equally close, and, to my astonishment, the cock proved no easier to make out than the hen when on the nest. This was due to the simple fact that unless there had been bushes or other substances serving as a screen, even the dull colored hen would have been seen against the bare ground at a distance of several hundred yards; but inasmuch as there was a screen, which hid the birds without regard to their color, neither cock nor hen paid any heed until the intruder got within forty to a hundred yards; by that time the sitting bird, whether cock or hen, ceased to feel safe, arose, and fled. In this case, therefore, we find two birds, the male and female of the same species, having exactly the same habits, living in exactly the same surroundings, one with a highly advertising coloration, the other with a countershaded concealing coloration; and neither coloration has one particle of effect, to the advantage or disadvantage of either bird. Their way of life is such, their eyesight is so good, their power of lying still and using cover as a screen while on the eggs is so marked, and their wariness and speed at other times are so great, that the effect of their coloration upon their safety is absolutely nil. This is a noteworthy and interesting fact, of genuine importance when we come to consider the effect of concealing coloration upon smaller birds whose habits we are not able to judge from the same plane of common size.

There are many water birds, and a few land birds, which while far inferior in size to the ostrich are yet big enough for us to judge fairly well their qualities of concealment or the reverse. The big African bustards are of the number. These are stately, handsome birds, heavier than a turkey, but standing more like a crane than a turkey, and living in the open. They are equipped with exquisitely delicate tracery patterns, the general effect of their coloration, in most species, being neutral, with strong countershading. But in short grass, on the plains, they are conspicuous at a long distance when standing erect, or walking; their countershading and neutral coloration are of no effect in enabling them to escape notice where there is insufficient cover, and under such conditions they rely for safety purely on their wariness and keen sight. When nesting, or when tired, they seek to escape notice by crouching, always in long grass. Under such circumstances they trust only to the screen of the cover to protect them. The minute pattern of much of their head, neck, and body coloration cannot possibly be of assistance to them; it is the cover that screens them; aided perhaps by the general neutral tint of their plumage, although of this I am

not sure, for some of these big birds which possess advertising marks seem equally difficult to see in the same cover. The countershading is of no consequence to them one way or the other, for it becomes practically negligible when they crouch in thick cover. But the young which rely on hiding for protection, and always seek cover, are probably benefited by their coloration and possibly by countershading — although as regards this last suggestion I am by no means sure, and would like to get the statements of practical observers who have seen the young in a state of nature.

The beautiful African crested crane has a strikingly advertising coloration and the adults never seek safety in concealment. The same is true of our nearly extinct whooping crane. The sandhill crane has a much less advertising coloration; but it no more trusts to concealment than does its bolder-colored brother, the coloration being of no consequence one way or the other to the adults, as far as escaping observation is concerned; the young, however, often seek to hide in cover, using it as a screen, and although as regards them the cover screen must be altogether the chief element in concealing them, it may also be that the coloration plays a subordinate part.

As regards the big waders, the birds of the water's edge and the marsh, coloration plays no part at all in the concealment or protection of the great majority of the species. In North Dakota, Texas, Louisiana, and even in Florida, New York, Maine, New Jersey and California, and above all in Africa, I have watched the big waders and swimmers for hours at a time, under all circumstances; and there are certain facts of which I am sure, and of which any observer, trained or untrained, can be sure if he will watch the birds under favorable conditions, trying really to observe what he sees, and not merely endeavoring to twist and upset the facts so as to make them fit some impossible theory.

The coloration of flamingoes, spoonbills, black and white storks, white, red, black or glossy ibises, and white herons, is in the highest degree advertising. Nevertheless I doubt if this advertising color puts them at even a slight disadvantage compared to the other waders of the same or closely allied genera, and of similar size, which are slaty blue, purple, brown, green, or of varied or even neutral tints. Their habitat and manner of life are such that concealing coloration confers no benefit whatever upon them and advertising coloration does them no harm. No coloration makes the slightest difference to them in catching their prey; this is proved by the fact that the great white heron and great blue heron, and white egret and little blue heron, catch their prey with percisely equal facility in precisely the same surroundings and under precisely the same conditions; yet their colorations are as diverse as it is possible to imagine; so that it is physically impossible that the coloration can have the least effect on their

ability to catch their prey. Indeed the great white heron and the reddish egret each has one white and one colored phase, which prosper indiscriminately. Some of the herons, like the Florida blue heron, have no countershading; others, like the Louisiana, are countershaded, or have white bellies; and neither the presence nor the absence of the countershading makes the slightest difference in concealing the bird or in rendering it easier or harder for it to escape its foes or capture its prey. The nuptial plumes have on the whole a slightly advertising effect (under normal conditions they cannot possibly have a concealing effect once, where they have an advertising effect a hundred times).; but the birds are so conspicuous anyhow that the effect of these plumes is of no consequence either way, and in the breeding season the great majority of the species gather in heronries which are so conspicuous — both the heronry itself and the individual nests and the old birds and the young birds — that no plume or nuptial ornament, nor minute pattern, would have the slightest effect either for advertisement or concealment. A curious light is thrown on Mr. Thayer's theory that the white herons are white so as to deceive their prey in the water, by the fact that the commonest white heron in Africa, the little cow heron, which accompanies in flocks the elephant, rhinoceros and buffalo, as well as domestic cattle, is almost purely a land bird, living on the insects disturbed by the feet of its huge, clumsy hosts, and, because of its coloration, being as conspicuous as a bird of its size can be. There are however certain small, generally dull colored members of the heron family, which skulk among the reeds, and are sometimes difficult to see. It would be well worth while to study these birds so as to find out whether they are hidden purely by the screen of reeds, or whether their coloration helps to conceal them. I believe that the coloration of certain bitterns is concealing, and that the bird takes advantage of this feature of its coloration; whereas in the lives of most herons neither cover nor coloration count for anything and the habits of the birds show that they do not trust at all to escaping observation. One small African species of heron or bittern displays much white when it flies, and is then conspicuous; but the instant it lights and folds its wings the white vanishes, and the dull-colored bird eludes the eye against the mud and reeds.

The ralline birds offer somewhat similar problems. The true rails are finished skulkers. They may swarm in a marsh and never be seen unless put up by a boat at high tide. Their coloration is varied, but on the whole is not advertising, and it is probable that as regards some species it has some concealing value. But if this is true, then it is difficult to account for the fact that the coots and gallinules, which live less in the reeds and are more aquatic, and have greater need of concealing coloration, are nevertheless

equipped with what is really a revealing coloration. They are practically monochromes; many of the gallinules are iridescent. Mr. Thayer considers iridescence "concealing" (which of course it is not, as any human being can tell by looking at the first crow or grackle he comes across); if this were the fact, the further fact would remain that the coots, among the most abundant and widely spread of all waterfowl or waders, are dark slate or blackish without iridescence or countershading. The rails seems to be protected chiefly, and perhaps purely, by their skulking habits and method of progress and by the impenetrable screen of the thick cover in which they dwell; indeed keeping in mind the fact that the coots and gallinules which live more in the open are without concealing coloration, it is difficult to believe that their coloration has any effect, one way or the other, upon any of these birds, rails, coots or gallinules, whether in concealing them from their foes or from their prey. It certainly has no effect whatever as regards some of the species. The coots cannot owe their safety to their coloration; if the varied and countershaded coloration of the big rails is concealing then the non-countershaded monochrome of the coot cannot be nor yet the glittering iridescence of the gallinule — except in so far as it may be said that on mud flats and among reeds any dark hue is concealing, any color except white, crimson, or yellow. But the coot lives largely in open water, where its coloration is exceedingly conspicuous.

The jacanas have a highly advertising coloration, and live in the open.

There are certain smaller waders which possess coloration as markedly advertising as those of the storks or ibises. Such are the avocets, stilts, oyster-catchers, turnstones, and the American black-bellied and golden plovers, and many African plovers and coursers. The avocets, stilts, oyster-catchers, and turnstones, except one or two species which are entirely black, are black or brown above, and white below; the black-bellied and golden plover are black below and white or white and brown above. Mr. Thayer speaks of the former as countershaded, and therefore obliteratively colored. If by countershading is meant black prevailing above and white below, then they are countershaded; but such "countershading" represents one of the most highly advertising species of coloration. However, Mr. Thayer says that the golden and black-bellied plover are also inconspicuous just because they are black below. Of course both diametrically opposite patterns cannot be obliterative; and as a matter of fact neither is. In the chapter (XIII) where he deals with these patterns, Mr. Thayer explains that "perfect uniformity of coloration makes a thing conspicuous." If this is so, and his first statements are true, then the black oyster-catcher is conspicuous and the other birds I have mentioned are not. As a matter of fact all are exceedingly conspicuous. Apparently when Mr. Thayer

makes statements like this he forgets what he elsewhere says about pure white birds like herons, dull black birds like dusky grouse and coots, and iridescent birds like crows. At different times he contends that *all* their colorations are concealing; and usually when he is thinking only of one species of coloration, as in this case, he says it is concealing because it is *not* like the others which elsewhere he says *are* concealing. He does this again and again. He says the eiders are protectively colored because they are white above and black below;[1] if he would take the trouble to glance at any book on ornithology (or of course to go out on the winter seas off New England, or on Puget Sound, or inquire of anyone who has sailed north of Nova Scotia or British Columbia) he would see that the scoters, which have substantially the same range as the eiders, are black above and below; that the old squaw, which has the same range, is black and white above and below; that the golden-eyes, with a range which partly coincides with and partly overlaps the range of the eider, are white below and black above; that other ducks of the same regions are totally differently colored; that some geese of the same region are white, some blue-gray, some almost black, some of varied colors. Now, these colors cannot all be concealing. If it is concealing to be black above and white below, it cannot be concealing to bear the colors exactly reversed; or to be black all over; or to be white all over; or to be pied; or to be of mixed colors with a pattern of a totally different kind. Mr. Thayer's statement if true of one set of species must be untrue of all the other sets of species; and as a matter of fact it is not true of any. The fact is that all the black, the white, and the boldly marked black and white, swans, geese and ducks have coloration patterns which are in the highest degree advertising; so have the sheldrakes, mallard, bufflehead, spoonbill, wood duck, canvas-back, redhead and scaups, as far as the drakes (and in some species the ducks) are concerned. But some of the females of these species do seem to have coloration patterns which are concealing or may be so under some circumstances; a serious study of these birds would be of genuine interest, if the student would by actual observation seek to find out whether the female's coloration does actually conceal her when on the nest, and whether at other times it confers upon her any advantage as compared with

---

[1] The eider drakes of many species (but not of all species) are thus colored. The females are generally dull colored, and may be concealingly colored. The young in the down are very possibly concealingly colored; one mounted in a squatting position (the position it would take), in the American Museum, shows no countershading. An unprejudiced and capable observer of these birds in their homes would be able to tell us whether in the nesting season the females and young are, either or both of them, protectively colored, and whether they behave accordingly. Mr. Chapman's photographs (in his 'Camps and Cruises') show that both questions must probably be answered in the affirmative; the photograph on page 412 also shows the great conspicuousness of the male eider, when on the rock near the female.

the brilliant suit of her mate, and whether the young are concealingly colored. It would be interesting to find whether any real difference under the circumstances of their actual lives in nature is caused by the fact that many of these birds are countershaded, while others, such as the swans, snow geese, dusky ducks, and harlequin ducks are not countershaded, and yet others, such as the black-bellied tree duck, are inversely countershaded, being darkest below. Apparently the countershading has not the slightest effect, one way or the other; of two closely allied species, such as the mallard and dusky duck, or various tree ducks, one may possess it and the other not, and yet both may have the same habits and thrive equally well.

Mr. Thayer's theory when he applies it to other water birds breaks down even more completely than when he applies it to ducks and geese; and this largely because he seeks to apply it to classes of cases which are mutually exclusive. He gives a picture of guillemots (murres ?) designed to show that their "ruptive" coloration, black with a white breast and belly, hides the birds, the white fading into the sky, the black into the rocks. His own picture shows the reverse is the case; the coloration of the murre is always advertising, the white revealing it instantly when on the rocks, and the black at other times. Moreover Mr. Thayer ought to have known that there is one guillemot completely black, with a white spot on the wing coverts, and, if the white belly concealed one guillemot, the black belly would reveal the other. The auks, puffins, guillemots and murres all have advertising coloration, some practically monochrome, most of them boldly bicolor; a point worth trying to work out is the reason why some live in burrows and others nest on bare rocks. Mr. Thayer believes that the cormorants are helped in catching their food by their nearly uniform dark coloration; in which case of course the bicolored plumage of the loons, auks, puffins, and murres would harm them. Neither supposition has any warrant; all these sea birds have advertising coloration; and so have the loons, most grebes, all pelicans, practically all gulls, and most petrels. Mr. Thayer supposes that a white under surface renders soaring, raptorial birds, such as gulls and most hawks, almost invisible to their prey; a supposition he can only maintain by forgetting birds like noddys, skuas, black terns, brown pelicans, brown gulls (the young), shearwaters, rough-legged hawks, various black hawks, and above all those most formidable of raptores, the eagles — all of which are black or dark brown, or some other dark color, below. The fact is that all birds which fly or soar while on the lookout for their prey are so conspicuous anyhow that their coloration has not the slightest concealing or revealing effect one way or the other; and their coloration patterns and countershading, when present, have no effect whether in either helping or hindering

them in the chase of their prey. This is as true of the white gyrfalcon as of the "black" gyrfalcon; of the sharp-shinned hawk or the goshawk as of the black rough-legged buzzard or black band-tailed hawk; of the common duck hawk as of the black peregrine falcon. Our commonest small hawk in this neighborhood, the sharp-shinned, for instance, goes everywhere; it is now in the open, now in the woods; by no possibility could its color conceal it in all localities; and as it is constantly in motion, its coloration in fact never conceals it at all. White-headed eagles, golden eagles, swallow-tailed and white-tailed kites, and many other birds of prey possess strikingly advertising coloration; very few birds of prey are concealingly colored in their natural surroundings. They all pounce with great speed on their quarry, from a distance which renders it absolutely impossible that their minute coloration patterns could in any case be of the slightest assistance to them.

Kingfishers have an advertising coloration; their habits conclusively prove that concealment plays no part in helping the adults to avoid their foes or to catch their prey.

In dealing with the smaller common birds of farm, garden, forest and prairie it is of course not possible to discuss them individually in an article like this. But it is possible to treat of certain general considerations and to treat most of the birds in classes. The claim that a large number of birds each colored utterly unlike the others both in tint and pattern and all living in substantially the same surroundings, are all concealingly colored, can never be tenable. All that is necessary for anyone to do in order to see this, is carefully to study the birds in his immediate neighborhood; constantly keeping in mind the effect of mere size in rendering a bird conspicuous or inconspicuous, and the fact that cover may and generally does act as a screen entirely independent of color. Here, near my house, for instance, there is a hedge or tangle running on one side of the garden and of the back road. In this are to be found thrashers, towhees, catbirds, chats, indigo buntings, and Maryland yellow-throats (together of course with other birds). All six of these birds, if the size of crows, would at once be recognized as conspicuously colored. The red of the thrashers, the gray of the catbird, the boldly varied black, white and chestnut of the towhee, the olive green upper surface and bright yellow under surface of the chat, the black mask varying the green and yellow of the yellow-throat, the uniform iridescent indigo of the male bunting and the uniform lustreless brown of his mate, are as different from one another as they can possibly be, and are equally different from the really inconspicuous, dull, countershaded, largely streaked coloration of one or two species of sparrows, such as the bush sparrow, which live in the same kind of thicket. Seen from

any angle, these colors are so utterly unlike that it is impossible that they can all be concealing. From a level the bright yellow breasts of the chat and yellow-throat are vivid to the eye; the towhees and the cock indigo bunting are for their size conspicuous from every standpoint. From above the backs of the different birds are respectively olive green, reddish, black, blue, gray, and brown. The fact is that not one of these birds really has a concealing coloration; the towhee cock (and to a somewhat less extent the towhee hen) and the indigo cock bunting and cock Maryland yellow-throat are advertisingly colored; and so is the chat unless seen directly from above. They owe their concealment to the cover, and to their personal habits. The chat is a very voluble bird, and apt to cut queer antics in the air; its coloration is much more conspicuous than that of the catbird; but it is so shy, and hops and dives in and out among the underbrush with such furtive agility, that it is far harder to see than the catbird. Birds with bright under colors or breast colors like the towhee, chat and yellow-throat are not helped by countershading, which in their case has no concealing value whatever; as regards all the birds in question the countershading is without concealing effect of any kind, unless, very dubiously, in the case of the thrashers; and even as regards the thrashers I doubt very much whether there is any effect, for the foxy red upper parts are generally advertising, and the bird relies for escaping observation upon the thick cover and its own skulking ability. Habit and cover are all important, and the coloration of no importance, as regards concealing these birds and helping them escape from their foes. This is seen when they are menaced by hawks. I have seen at different times hawks stoop at catbirds, mockingbirds and thrashers, all birds of similar habits. Twice the hawk caught the bird at the first stoop. But I saw one bird of each of the three species escape. In each case the hunted bird dove among the branches of a tree or bush, lit, and remained motionless; twice the hawk also lit and looked around, on the third occasion the hawk checked itself and swung round in the air; in each case the hunted bird, before it was again seen, flew suddenly, dodging around the tree and through the branches, and got into such thick cover that it escaped. The mockingbird showed the white on its tail, conspicuously, as it flew and shut the tail when it lit, so as to cheat the eye; but the catbird and thrasher had no white on their tails and yet pursued precisely the same course. Evidently in each case the bird in its desperate need flew into the first available, even partial cover, and crouched motionless to escape the eyes of its pursuer; and then again flew, getting just a little start, and whirling into such a mass of twigs and leaves that its dodging ability rendered it safe. As the three birds are totally differently colored, it could not have been their coloration which enabled them to escape for

the moment the hawk's eyes; he lost sight of them because, in the cover they suddenly stopped and remained motionless, and then dodged off before his eye could pick them out.

In the high woods of oak, hickory and chestnut, at the foot of the hill near my house, the birds are different from those in the hedges of which I have spoken. (I treat only of those that are most common). Ovenbirds stroll about on the ground, wood thrushes perch above them, among the lower branches, and higher up come wood pewees, black and white creepers, downy woodpeckers, red-eyed vireos, cuckoos, blue jays, great-crested flycatchers (also found near the house) and scarlet tanagers. The last five are often found among the tree tops, together with various species of warblers during the migrations. Anyone can see that these birds possess many different kinds of coloration. The wood pewee and red-eyed vireo are the least conspicuously colored; yet neither endeavors to hide, and as both are continually in motion, the pewee making intermittent swoops, and the vireo hopping and crawling with leisurely but unintermittent activity among the twigs, they are readily seen. To my eyes the black and white creeper is a conspicuous little bird. But the only birds which are really difficult to see are those that haunt the tree tops. This is because the light is in the eyes of the gazer, and because the leaves and twigs make a mass of confusing objects, with vistas of every length opening among them, and all shot through with a shifting play of light and shadow, so that there are all kinds of color tones. The male tanager is hard to see amid such surroundings, because he is at such a distance that he seems very small, and is easily screened or hidden in whole or in part, for in such surroundings any object is hard to pick out. But he is much easier to see than his greenish mate, or than any of the other less brilliant birds such as the cuckoo; his coloration is in the highest degree advertising; it does not harmonize with the surroundings so as to make him less conspicuous; but his surroundings are such that even his advertising coloration is not as glaringly conspicuous as it would be elsewhere.

Around the house, among the scattered trees and bushes, and on the grass, the birds are seen near by, and are far easier to mark. The Baltimore orioles are very conspicuous; their coloration is never concealing, and under all normal circumstances is highly advertising. The meadowlark tries to conceal itself; its upper coloration is distinctly concealing; but its black and yellow breast is highly advertising, and is very conspicuous when the bird is singing, while it is hidden when the bird crouches or skulks through the grass. The coloration of the robin is less advertising than that of the oriole, and much less advertising than the coloration of its cousin

the European blackbird,[1] which is singularly conspicuous. Nevertheless it is distinctly advertising, having ordinarily a revealing, and hardly ever a concealing effect. How anyone can look at this familiar bird, and believe that it has a concealing coloration is past understanding. It is always conspicuous; it never tries to hide; as nests go, its nest is conspicuous, and the eggs are of a conspicuous color; its coloration, its ways, its boldness, all alike advertise it. Its abundance, and evident success in life, prove how small a part concealing coloration plays in evolving or preserving some of our commonest and best known species. The flickers are conspicuous birds of advertising coloration. When the bluebirds visit us a glance is sufficient to note the highly advertising quality which their coloration possesses under all normal conditions. The kingbirds likewise have a highly advertising coloration; they are conspicuous even when nesting; they rely for safety upon their boldness and truculence. I do not suppose that anyone can deny that the thistle finches have a strongly advertising coloration. The cow buntings that stroll about in the grass are also advertisingly colored, and never seek to hide. But the grasshopper sparrows run through the grass like mice, and while their skulking ability and the cover itself play the leading part in protecting them, their coloration also helps to conceal them. On the other hand the song sparrows, which sometimes nest almost alongside them, do little hiding, and are rather conspicuous little birds. The chippy also is not much given to hiding.

I have thus mentioned a couple of dozen common birds, among the species easiest to study at our very doors. Over half of them clearly possess advertising colorations; that is, all, or some main feature of, the coloration pattern, instead of tending to conceal the wearer, tends to reveal the wearer, under normal conditions. One species, one of the grass sparrows, is an adept in hiding, and has a coloration which clearly aids it in hiding; that is, its coloration is concealing. (In none of these birds is the countershading of any consequence; those which possess it are no more difficult to see than those which do not.) The meadowlark also has a concealing coloration above, which is evidently much trusted by the bird; although its coloration below is advertising. Many of the birds living near the house are birds of scattered groves; some of them are birds which spend their time on the ground; and such of these as possess advertising coloration are really advertised thereby. But the birds of similarly striking colorations which

---

[1] The European blackbird is certainly most conspicuously colored compared to its close kinsman the European thrush; it is certainly impossible to account for the development of two such diverse types of coloration in two closely allied species of substantially similar habits by any theory of natural selection working towards the development of concealing coloration.

live in the high forest and in the thickets may in reality not be advertised thereby. As a rule, in such cases, the bird's caution, and skill in skulking and hiding, and above all the protection given it by the cover, and the way in which it tends to become lost in its infinitely varied background, all tend to make the coloration of little consequence one way or the other in concealing or revealing it. Of course, this is much less true of those birds with the most vivid coloration; a tanager's coloration is advertising even in the leafy treetops; but it is not as advertising as a Baltimore oriole's is in the oriole's ordinary surroundings. Alertness and ability to dodge among twigs probably count for infinitely more than coloration in enabling most of these birds to escape hawks. But I wish that ornithologists would study these questions closely enough to enable us to tell just what trait or quality it is that enables cedar birds, for instance, which are rather conspicuous, and take comparatively little advantage of cover, and do not seem especially good at dodging, to escape from hawks. What an infinite amount there is yet to learn about even our common neighbors in the world of birds and mammals!

Of course an equally limited area elsewhere might yield a larger percentage of birds with concealing coloration. A little over a year ago, one day in upper Egypt, I rode across a narrow strip of fertile land to the desert's edge. I noticed in the fields white cow herons and black and white spur-winged plover, both birds with colorations so advertising as to be fairly spectacular. There were also a few quail, and numbers of crested larks, in the fields. Both crouched flat on the ground, both were helped by their coloration, and both, especially the former, were difficult to detect. On the edge of the desert I saw desert larks, desert chats, and black and white chats. The latter possessed a strikingly advertising coloration; they stood erect and alert; they never tried to escape observation by crouching; and they could be seen a quarter of a mile away. The desert larks and desert chats, on the contrary, were colored above in beautiful harmony with the desert sand; they crouched flat, and were very difficult to see until closely approached; their ornamentation was purely on the breast, where it was vivid and advertising, but was normally invisible to the birds' aerial foes.

In many families of birds with small, weak feet which spend most of their time on the wing, the colors of almost all the species are advertising. A flying bird is never concealed, and no coloration can conceal it; a dull colored bird in flight is sure to be seen almost or quite as quickly as the most gorgeous sun-bird or bee-eater. Not only the sun-birds, bee-eaters and hummingbirds, but the great majority of the swallows, the diurnal swifts, and the kingfishers, are advertisingly colored.

Only the small size of the wood warblers and the difficulty of observing

them clearly in the high trees and thick shrubbery can blind anyone to the fact that the plumage of most of them is in the highest degree advertising. The prothonotary, the blackburnian, and the redstart for instance, can hardly fail to attract attention unless they are actually screened from sight; and the same can be said for the Kentucky, mourning, magnolia, black-throated blue, black-throated green, blue-winged, golden-winged, and dozens of other warblers. With most of them it is the nuptial coloration of the males that is advertising; the fall coloration is much less conspicuous and may even on the whole be concealing, in so far as it is true that any dull colored bird is hard to make out in the infinite variety of color effect and distance effect incident to life among leaves. The males in the nuptial plumage are not really countershaded, the brilliant white, yellow, black or red of the underparts, having no obliterative quality and being on the contrary highly advertising, just as is the case with the head and throat colorings, and some of the back and tail colorings. Some of the warblers, however, are always dull colored, their coloration patterns being as inconspicuous as those of the vireos and smaller flycatchers.

I have already incidentally alluded to the fact that some of the flycatchers as the phœbe and the wood pewee, because of their habits are always readily observed, their concealing coloration being apparently of no value to them (whereas it might be of great value to them if they had the habits of the grass and brush sparrows). The black phœbe has an advertising coloration, and the Say's phœbe has not: yet the habits of both are such that the latter is as conspicuous and as easy to see as the former. Now, especial attention should be paid to the entirely different life-value of concealing coloration — or what seems to us concealing coloration — in the two classes of cases typified by the wood pewee and phœbe on the one hand, and the desert chat and desert lark on the other. The wood pewee and phœbe are inconspicuously colored birds whose colors harmonize well with the greens prevalent in their habitats during breeding time; yet they make no effort to hide, they are noisy, they perch upright on twigs or stakes, continually making swoops in the air, and they haunt the same neighborhood, so that a pair of them once found can be visited day after day with the certainty of again finding them; and finally their ways of life differ in no essential from those of their kinsfolk with advertising coloration, such as the black phœbe, and even the vermilion flycatcher — which latter by the way not only has a strikingly advertising coloration, but has habits which give the fullest possible advertising effect to this advertising coloration. I cannot see that in their case the concealing coloration really has a concealing value, for it seems a negligible quantity in the bird's life. On the other hand the slightest study of the North African desert chat and desert lark

shows that their coloration has a real concealing value, and that the birds take full advantage of it by continually crouching motionless in places where it will redound most to their advantage; and the habits of the desert chat are in striking contrast to those of its kinsfolk, the conspicuously colored black and white chats. In one set of cases the apparently concealing coloration does conceal; in the other set of cases it does not. It is of course possible that in the one set of cases it has really been developed by a process of natural selection, and in the other has been developed because of some totally different reason, the birds' habits being such that the persistence of the species is unaffected by the coloration, whether it be advertising or concealing, conspicuous or inconspicuous — or at least the effect being so trivial as to be counter-balanced by the other considerations, whatever they may be, which have actually produced different coloration patterns in, for instance, the black phœbe and ordinary phœbe. In the case of the desert chat and desert lark it is of course also possible that their concealing coloration has not been developed as an incident of natural selection, but that they have suited their habits to it, instead of its being developed as suitable to their habits.

The nighthawks and their allies, most of the grouse, partridges and quails, and certain of the snipe family, such as the woodcock, and true snipe offer admirable examples of concealing coloration which really does conceal, and of which the owners take full advantage.[1] A whip-poor-will crouched lengthwise on a mossy limb, a nighthawk on a ploughed field or a leaf strewn bit of sward, are marvellous examples of protective coloration; and both the general hue and the pattern help in rendering them indistinguishable. When the birds are crouched flat, which is always the case when they are endeavoring to escape observation, the countershading is so slight that I doubt whether it has much if any effect in concealing them. Many of the woodland grouse when standing in the dim light of the woods are, I believe, helped by the countershading; for their coloration harmonizes with the surroundings, and the countershading tends to soften the outline, making them look

---

[1] Mr. Thayer's pictures are ingeniously arranged to support an impossible, indeed a preposterous, theory. Contrast them with the photographs taken merely to aid in finding the truth; such as those in Mr. Job's 'Wild Wings,' 'Sport of Bird Study,' and 'Among the Waterfowl,' and in Mr. Finley's, 'American Birds.' Mr. Job's photographs of nesting nighthawks, whip-poor-wills, grouse, quail, woodcock, snipe, and least sandpipers show birds that actually are concealed by their coloration when on their nests. His photographs of nesting gannets, murres, guillemots, black skimmers, ibises, noddies and pelicans, and his and Mr. Finley's photographs of nesting gulls, terns and herons of many species show birds of a strikingly advertising coloration which coloration reveals them to every onlooker as they sit on their nests. The young herons, although not as advertisingly colored as the adults, have a revealing rather than a concealing coloration; the young anhingas are even more advertisingly colored than the adults; the young of some of the other birds seem to be concealingly colored.

like, or be merged among, the less conspicuous among the surrounding material objects (all of which show with varied conspicuousness under the varying lights and shades) so that the eye has difficulty in picking them out. A grouse standing up on a bare plain is always conspicuous, the effect of the countershading being insufficient to prevent this. But grouse in the open country are generally in more or less long grass or among bushes, and crouch whenever they expect danger; they owe their inconspicuousness to the cover and to their general coloration, the countershading being often negligible under such conditions. In the Old World there are grouse, the capercaillie and blackcock, with distinctly advertising coloration. There are features in the colorations of three of our own grouse which deserve attention. The ranges of the dusky grouse, and two subspecies of ruffed grouse and spruce grouse, overlap. Now all three species are colored differently. The spruce grouse, thanks to the black of his throat and underparts, is in part advertisingly colored, and is not countershaded. The ruffed grouse is countershaded, and its beautifully varied pattern of coloration has a strong concealing quality in the woods. The dusky grouse is of almost uniform dark hue. But all three are difficult to see. I think that it is the thick cover in which they are found, and the ability to remain motionless which count for most in concealing them; and that the different patterns in their coloration amount to comparatively little, any dull tint or combination of tints being sufficiently effective in the deep forest. The hen grouse on her nest, whether in the open or in the woodland, is certainly helped to concealment by her coloration; I doubt if the countershading plays much part, but it may play some; and the mottled patterns, and dull nearly uniform patterns, are all equally effective in hiding the motionless mother, as she sits until nearly trodden underfoot. In short, with grouse habit and cover count for most in their concealment, but in some of the species the coloration also counts very materially, and under certain conditions it is possible that countershading is of some slight, but not very serious, value; and in some of the species with the same way of life as the others, the coloration is, in whole or in part, either revealing, or at least not concealing, especially in the males. This latter fact emphasizes the immense importance of habit and cover compared to coloration, even where the coloration has a concealing quality.

Some of the American quails or partridges are marked in totally different fashion from others that live under practically the same conditions of color surroundings. The beautiful, plumed mountain and valley quail of the Pacific slope are utterly different in ornaments and coloring from homely bob-white of the East; yet in their habits all three are substantially alike. It is the cover, joined to their cursorial habits, far more than their colora-

tion, which conceals them; indeed I should hardly call the western birds concealingly colored at all, and they are really inversely countershaded. Under most circumstances the head colorings of all of them, but especially of the two western birds, are advertising, and as in one the throat is black, with a white edge, and in another, the eastern bird, white with a black edge, to call both concealing is merely to say that there is no difference between concealing and revealing colorations — in which case of course all talk of concealing coloration is waste of time. But the female bob-white, when sitting on her nest, is concealingly colored — although when in this position she is not countershaded. The extraordinary scaled and Massena partridges are not countershaded; and I should like to learn from trained and trustworthy experts about their habits and haunts before I said that they were concealingly colored.

The woodcock's beautifully marked and shaded plumage is certainly concealing; and this apparently not only because of the tint but of the pattern; and the countershading may in this case be a real help towards the end, concealment. A nesting woodcock, like a nesting grouse, evidently appreciates her inconspicuousness, and sits very close — for it must always be kept in mind that no coloration can have any concealing value unless the bird or mammal so acts as to take advantage of it. There are a number of grass-haunting sparrows which are certainly concealingly colored, to the extent that the general effect of their coloration is dull, so that it does not attract the eye. But I doubt very much whether Mr. Thayer's minute working out of the likeness of the "patterns" of these and other birds to grass blades, little sticks, etc., has much, if any, justification; it seems more likely that the minute portions of any patterns have no effect one way or the other upon the bird's invisibility, and that, especially in these little birds, it is only the general color effect that counts; while the coloration, itself, even if concealing, plays an insignificant part in the birds' concealment compared to the effect of the cover in which it dwells. Most of the grass-dwelling ground sparrows are streaked; but the seaside finch, which lives side by side with the streaked sharp-tail finch is practically a monochrome above; and yet the two birds hide equally well and are equally prosperous. Evidently the difference in pattern of coloration makes little or no difference as regards concealment. On the other hand, the sparrows that live in bushes, or perch freely in them, are often colored substantially like those that run like mice through the tall grass; but they are as easy to see as the others are difficult to see; no one can help noticing a song sparrow or a chippy, and no one but a skilled expert will even suspect the existence of a Baird's bunting or Henslow's bunting. Evidently the concealment is primarily due to the way the birds take advantage of cover; and natural

selection, if it has had any effect whatever on their coloration, has merely done so by establishing limits of conspicuousness, so to speak; and within these limits scores of coloration patterns have been produced, differing utterly from one another, but all equally concealing if the general effect is dull. Most of the sparrows and finches are probably not concealingly colored in the eyes of their foes. At any rate, their patterns of coloration are so diverse that it is impossible that any one of the patterns can in and of itself be concealing, unless the others are not. The utmost that can be claimed for any one of them is that the general effect is dull; and there are numerous forms for which even this cannot be claimed, as they are boldly and advertisingly colored, and yet are as successful in life as their dull colored cousins.

The streaked and spotted song sparrows of the various varieties, are among the most abundant of American birds; but so are the white-bellied, otherwise uniform slate or rufous colored, juncos; and also the chipping sparrows and their allies, with unstreaked breasts. The juncos certainly do not have a concealing coloration; they are boreal birds, called snowbirds throughout most of their range in the United States, and wherever there is snow their coloration is advertising; and if streaked patterns are concealing, then the coloration of the junco is revealing even during the nesting season while it is not countershaded at all, in the sense of the shading having any obliterative quality. Many of the finches with substantially the same habits as the relatively dull colored song sparrows and chippies, are really rather advertisingly colored; for instance the white-crowned, white-throated, golden-crowned, black-hooded, and black-throated sparrows. Their colorations are not strikingly advertising, as are the colors of the cardinal and the grosbeaks, but on the whole they reveal rather than conceal the birds in their native haunts. Among the sage brush, I always found the sage sparrow easy to see because of its black tail. In winter amid the snow of the Colorado mountains I have been struck with the conspicuousness of the leucostictes, the rosy and umber finches. The snow buntings and longspurs possess colorations each of which is in whole or in part advertising. The lark bunting is as conspicuous as a bobolink — which means that, for its size, its coloration is as advertising as that of a black or white swan. The evening, pine, rose-breasted, black-headed and blue grosbeaks, the crossbills, cardinals, thistle finches, purple and house finches and the indigo, lazuli and painted buntings have in one or both sexes strikingly advertising colorations. Many of these birds live in such fashion that it is obvious that concealment plays no part in their lives; others seek the concealment of thick cover, and seemingly profit by it as much as do their dull colored kinsfolk in the same places, in spite of the fact that their own

coloration is revealing, and not concealing. Remember, that in each case I am speaking of the bird as it would be looked at by its natural enemies; hawks, cats or weasels, especially hawks. The bobolink, for instance, is just as conspicuous from below as from above or from one side; the same is only less true of the robin, and is equally true of the grosbeaks; the Baltimore orioles outside my window at this moment, are equally conspicuous whether seen from the piazza below, from the second story on a level with them, or from the windows of the gun room in the third story above them.

Mr. Thayer speaks of the woodpeckers as obliteratively colored, the obliterative coloring of the northern forms being due to their black and white resembling "adequate generalized pictures of bits of winter landscape" — which if true would mean that they were not obliteratively colored in spring and summer, when breeding and when the young are growing, and the need for obliterative coloring is greatest. He states that the downy and hairy woodpeckers are whitest towards the north, where the "evident winter-picturing in their costumes" is most needed. This is a typical instance of his hasty generalization from, and refusal to face, facts. The three-toed woodpeckers, the most northern of all, have less white in their plumage than the hairy and downy, one having an entirely black back; and the big northern log-cock has less white than the still bigger southern ivory-bill. The southern red-cockaded, Texan, and Nuttall woodpeckers have more white in their plumage than have the three-toed woodpeckers of the sub-arctic forests. Most of the woodpeckers of the United States have a strongly advertising coloration; the ivory-bill, log-cock, red-headed woodpecker, white-headed woodpecker, California woodpecker, Lewis's woodpecker, the sapsuckers, and flickers. All of these I have myself closely watched in their homes; and also the red-bellied. As to the coloration of the last, I am in doubt whether to call it concealing or not; in the great Louisiana swamps where I studied it, it was rather hard to see, but I think this was due to the fact that it was generally among the tops of the giant trees, and I question whether its coloration would have seemed concealing to a hawk. The red head was certainly advertising, and the belly too, wherever it could be seen at all. As for the hairy, the downy, and the three-toed woodpeckers, I do not think that their coloration is really either concealing or advertising. The brown creeper has a concealing coloration, and no doubt profits by it; but the nuthatches and the small woodpeckers never seem to me to be concealingly colored. If the forest is thick, they cannot be seen a long way off, and if the trees are high, they, because of their size, are difficult to make out among the tops. But both the woodpeckers and the nuthatches are noisy; the former are always drumming as an incident of earning their livelihood; and the latter keep uttering their unmistakable notes; so that

it is difficult to avoid knowing of their existence if any are in the neighborhood; and once placed by sound, both their coloration and their busy restlessness make them rather easy to observe. At any rate, if the coloration of the tree-creeper is concealing, then the coloration patterns of the nuthatch and the downy and hairy woodpeckers are not, and if the white and black back of the two woodpeckers is concealing, then the uniform slate blue of the nuthatch's back is not. Evidently habit, and secondarily cover, are all important with the nuthatches and woodpeckers, and their coloration a well nigh or altogether negligible factor in protecting them from their foes — while no coloration would have any effect on their prey.

The crows and blackbirds contain a large number of species in most of which the coloration is strikingly advertising; and most of them live under conditions which forbid their getting much or any benefit from cover. The ravens, crows, magpies, piñon jays, nutcrackers, orioles, grackles, red-winged blackbirds, bobolinks, cow buntings, yellow-headed blackbirds, and many of the jays, are colored so that they attract the attention of the least observing. The ravens and crows, the blackbirds and grackles live in the open, where there is nothing in the way of cover to shield them from sight. The bigger among them may owe to their size and truculence a certain immunity from attack, just as the kingbird's boldness and agility may help him; but the bobolinks, cow buntings, grackles, and other blackbirds, and orioles are no larger nor more able to defend themselves than thrushes or larks. Evidently the need for concealing coloration has played no part in their development; and yet they also dispense with the ability to profit by cover which so often supplies the lack of concealing coloration.

I could go on with a long list of common American birds of advertising coloration, such as the beautiful scissor-tailed flycatcher, the Louisiana tanager, the phænopepla, the mockingbird, the shrikes; but I have said enough to make my case clear. There are certain important families about which I am in doubt. The wrens are dull colored little birds, as a rule; their coloration is certainly not advertising, and under many conditions it might well be concealing as regards certain species; yet what I have seen of the different species — the winter wren of the north woods, the marsh wren, the Bewick's wren, the Carolina wren, the house wren of the east, the cactus wren, which is rapidly becoming a very familiar house-bird in the southwest, the rock wren, the cañon wren — makes me question whether they really trust at all to their coloration for protection; for they are very wide-awake, are ceaselessly in motion, and dodge in and out among brushes and rocks with an agility that defies pursuit. The shore birds, the snipe, offer another problem. They are rarely advertisingly colored, aside from the nuptial markings of the males on certain species; and the general colora-

tion of a number of them I should be inclined to regard as on the whole concealing. But this is not a point which it is possible to settle by scattered observations, still less by theories evolved in the closet or from fanciful pictures. What is needed is careful and prolonged study in the field, to find out whether there are differences of habit among the species in so far as endeavoring to outwit their foes by eluding observation is concerned, whether any or all of them crouch motionless on the mud or sand or marsh to escape the observation of hawks; what the other foes of any of the species are; and which species never try to elude observation. Some of the species, like the curlews, godwits, willets, yellow-legs and tatlers, are wary about man; they do not seek to evade his observation, or trust in concealment so far as he is concerned (except the nesting females), being watchful and flying off while he is still a long way distant. The belly markings of some species are revealing and some of the species certainly never seek concealment or profit by it.

Everyone can observe for himself the nuptial colors, seasonal or otherwise, of many common birds, such as the tanager, summer redbird, red-winged blackbird, bobolink, Baltimore oriole, and if there is a single instance where the nuptial colors are concealing, and not advertising I am not acquainted with it. At any rate, in the immense majority of instances the nuptial colors, if they have any effect on the bird's conspicuousness in its normal surroundings, are advertising. I have rarely had the chance to observe nuptial appendages. The scissor-tailed flycatcher's tail can hardly be called a nuptial appendage, although in the female it is smaller than in the male; this graceful and beautiful bird is conspicuous in shape, in color and in habits, has no concealing coloration, and never conceals itself. Its long tail merely adds to its already great conspicuousness.

But in Africa I did see certain birds the males of which bore nuptial appendages; one of the nighthawks, and several of the whydah finches. The male of the nighthawk in question has two of the wing quills developed to an extraordinary length; they are bare of webbing except at the very end. When the bird flies the two broad tips flutter behind him like a pair of butterflies, and at first take the eyes off the actual bird by their conspicuousness. At first blush it would seem as if this might be a device of defensive value in the bird; but on thinking it over I doubt this. Any bird of prey (the only foe the appendage could deceive) would doubtless be able to single out and seize the bird's body anyhow, as the appendages would have no interest for it; and, what is more important, if they really did contribute to the bird's safety, it is likely that the female would also grow them, and that the other species which lack them would be crowded out instead of being the more plentiful. In the case of the whydah finches there is no doubt whatever.

The females of the different species are dull colored, inconspicuous birds, hard to recognize as of the same species with the males, which are variously, but always advertisingly, colored, in the breeding season, and with very long tail feathers. The males of some at least of the species make dancing rings in the grass in which they jump and posture. Their nuptial coloration, their nuptial plumes, and their habits in the nuptial season, are all three extremely advertising; and in addition their long tail feathers offer such a mechanical impediment to their flight as to make them noticeably slower and more clumsy than their mates when in the air. I believe that disinterested observation will develop the fact that the plumes and colors of male peacocks, pheasants and birds of paradise are what they look — highly advertising in so far as they have any effect at all. Great tropical forests are so bathed in color, and flooded with lights and shades, the vegetation is so dense, and the trees so tall, that it is easy for any bird to escape notice. Therefore in such a forest all birds of paradise may be difficult to see. But, as the females are totally unlike the males in color and in shape (thanks to the nuptial plumes), and as the males of the various species are totally unlike one another, one of three things must be true; either the female is more conspicuous than the male, in which case her color and failure to acquire appendages give her, as compared with him, an advertising quality — which would be hopelessly detrimental to the species, and of course unthinkable; or his coloration and plumage give him, as compared to her, an advertising quality; or else all the cocks and all the hens of all the various species, representing every imaginable variation in color and shape of plumage, are equally difficult to see, which would mean, not (as Mr. Thayer supposes) that the colors and plumage of the male have a concealing value, but that the surroundings are such as to render it impossible for any color, any appendage, any bodily attributes of any kind, to have any effect one way or the other in either concealing or revealing any one of the birds, male or female. Probably in actual fact, it will be found that the forest conditions are such as to tend towards making all the birds difficult to see, but that the wonderful plumage of the males does have a certain, although variable, advertising effect. Friends who have hunted in Asia, especially in the Himalayas, assure me that the cocks of most of the species of pheasants are extraordinarily conspicuous birds, their coloration being in the highest degree advertising, and their habits showing their knowledge of this fact; and that this is equally true of the peacocks and argus pheasants. [1]

---

[1] Messrs. Barbour and Phillips state (Auk, XXVIII, pp. 179–188, April, 1911) from actual experience, that in their native haunts male birds of paradise are very conspicuous and easily seen. The comments they make on the pigeons of the Papuaasian forests and on such birds as the snow-white cotinga of the tropical forests of South America are in themselves enough to show the baselessness of Mr. Thayer's extreme claims.

A careful study should be made of the concealing and advertising colors of nesting birds, their eggs and their young. Aside from eggs in burrows and in covered nests, the eggs deposited in open nests are of many different colors and patterns, and some of them are certainly advertising, tending to attract the eye instead of eluding observation, while others are inconspicuous. Very young birds, as a rule certainly seem to be less conspicuous than their parents, this being especially true of those that are active from birth; as regards many of them, at least, the coloration is concealing. It is difficult to account for the facts in some of the cases. Cormorants, herons, guillemots, murres, and many other birds build conspicuous nests or lay their eggs in conspicuous places, and their young are very conspicuous; there is no concealing quality about the nests, eggs, or young in the nest; and yet it would certainly seem as if such concealing quality would be very useful, for the rookeries of these birds are always haunted by numbers of gulls or crows, inveterate enemies of the young and eggs. The downy young of gulls and terns are (relatively to their parents) concealingly colored; but the old birds nest in masses, crowded close together, both the sitting birds and the eggs being so conspicuous that they could not escape the eye of any foe. Among the passerine birds, by far the most plentiful, the nest is usually difficult to find whether in the grass or in the bushes or trees.[1] The nesting bird usually sits very close. In burrows or covered nests her coloration does not matter. In open nests, unless they are very shallow, only the uppermost part of the body is visible, so that countershading plays no part in concealing the mother bird at the very time when concealment is most vitally necessary to her. Usually she is less advertisingly colored — and very rarely more advertisingly colored — than the male, and any bright colors that she does have are usually on her under surface; so that only the comparatively dull colored back is seen. But as regards a very large number, perhaps a majority of the smaller birds — the perchers — the back of the female, although not of an advertising, can not be said to be of a concealing, color. Kingbirds and robins nest right beside my house; the nesting bird in each case is conspicuous. In the bushes, nearby, the thrasher, catbird, and chat nest; and their reddish, gray, and olive-green backs, all among the same surroundings, cannot all be concealing, except as all colors save a few very varied ones may in such surroundings fail to attract attention — which would mean that the principle producing such coloration, if at work at all, does not produce or favor

[1] Mr. Thayer, who lays much stress upon the part played by "countershading" in concealment, should remember that nests are much more difficult to find than birds, although of course not countershaded; simply because the nest is screened and, in materials, resembles more or less the surrounding objects.

any one type, but merely sets bounds to the variation, and permits the unchecked development of any type which does not transgress the wide limits thus set. In most cases cover and immobility evidently count for infinitely more than color in enabling the sitting bird to escape observation; but there are birds, such as the nighthawks, most grouse, and desert chats, where the coloration itself is a very important factor — in a very few cases perhaps the most important factor, immobility being also essential, and cover not counting at all. In studying coloration one important field should be that covering the large class of cases where the young in their first plumage are unlike either parent, and where the young males then pass through a period during which they resemble the dull colored female, or, if the male's distinctive coloration is only worn during the breeding season, where they resemble both the female, and the male in his fall and winter plumage. There are very many such birds in which the coloration of both sexes is the same, and there is substantially no seasonal change, while the young, once out of the downy stage, resemble the parents; as is true with most of the dull colored sparrows, for instance. Sometimes, as with the gulls, both sexes are alike, and both may undergo seasonal changes in plumage, while the young are differently colored. In some hawks both sexes are alike when adult, and undergo no seasonal changes, while the young have a different and dull coloration. In other cases the sexes are unlike and the young are like the female. In many of these cases the change in coloration from immaturity to age has no effect on concealing the bird, even when the coloration of the adult is by far the more advertising of the two; yet in other cases it certainly seems as if the young were wearing a coloration which (whether the ordinary coloration of their remote ancestors or not) does have a concealing quality which may be of use to them, and which is lost in the adult. To endeavor to explain all these utterly different and contradictory phenomena by referring them to one manifestly inadequate cause serves only to darken wisdom, and to impede any effort seriously to ascertain the truth.

There is need of careful and intelligent study, in the field, of large groups of birds in order to determine all such points. Take the duck family for instance. In the swans the adults of both sexes wear the same highly advertising plumage at all seasons; the young have a dull coloration. The geese show substantially the same state of affairs. Are the young cygnets helped by their seemingly concealing coloration? If so, can we find any reason why the old birds have lost it? Most of the ducks show an entirely different type of coloration development. The males are advertisingly colored; they take no part in brooding the eggs; and during the moult assume substantially the colors of the females. The females are much duller colored

than the males, and while at most seasons their dull coloration probably makes little difference, it is possible and indeed probable, that, as regards many species, it is of real concealing value at the vital period when the birds are nesting. The young males go through a stage when they are colored like the females. A full and thorough investigation of the family must be made before all the various important qualifications and exceptions to the above statements can be set forth, and before any attempt can be made to assign reasons for the utterly different coloration phases which distinguish sex and age in the life-histories of the different species. But the above facts are substantially true as regards many species. It may be that these species are descended from more dull-colored forms; and that the brilliant plumage of the adult males — at certain or all seasons — has been especially developed, either by sexual selection, or by the mere intense vigor of vitality of the male, seasonal or otherwise, or for some other reason; in which case one sex has been changed from a possibly concealing to an advertising coloration, the forces telling in favor of the latter having overcome the forces telling in favor of the former. At present we are only able to guess as to these points. We know enough to recognize the absurdity of endeavoring to explain all the utterly different color phases of the ducks by some one universal cause, such as the development of concealing coloration by natural selection; but we are not as yet fully acquainted with the facts, and have no knowledge sufficient to permit us to generalize as to the complex tissue of causation responsible for these facts.

Before considering mammals, I wish to quote two or three sentences of Mr. Thayer, in which he states some very important facts with partial correctness, but with complete misapprehension of their meaning: "Species that live amidst vegetation are looked at through a certain average amount of interposed foliage and twiggery. . . . Since the whole panorama of outdoor objects is just one complexity of millions of outlines made by different colored objects relieving one against another, each one showing against a more distant one, it follows that amidst this vast embroidery, a scrap of imitation of it must generally pass unnoticed unless it takes the liberty of moving about. All the patterns and ornaments of the animal world are scraps of such imitation scenery, and their wearers are hunted both by man and beast in the same way — viz, the watching with a relaxed eye as large a tract as possible for the least hint of motion." It is not true that all the patterns and ornaments of the animal world are scraps of imitation scenery. No "scenery" is imitated by the coloration of a red-headed woodpecker or the tail feathers of a cock whydah finch in nuptial dress; and indeed the minute patterns, and many of the bolder and larger patterns, of most birds and mammals are not "scraps of imitation scenery" at all, and fade into the

landscape merely because at a little distance their details become indistinguishable and they all merge and blend into a single neutral shade of color. Moreover, Mr. Thayer's statement is in effect that every color or combination of colors as seen on a bird or mammal must "generally pass unnoticed." If this means anything it means that every color or pattern of colors is concealing — for birds and mammals are of all colors and combinations of colors. Of course the statement that every color is concealing is equivalent to the statement that no color or combination of colors can ever be revealing; or in other words that there is no such thing as concealing coloration, because there is no such thing as revealing or advertising coloration — for the existence of the one is only possible if we pre-suppose the existence of the other. The statement, then, would be a reductio ad absurdum of Mr. Thayer's whole argument, if it were true; but as a matter of fact, it is entirely untrue, as regards a multitude of animals, from prongbucks to ravens.

But while Mr. Thayer's exact words, applied universally, as he applies them, much overstate the case, he does describe very accurately certain situations, and incidentally disproves his own thesis by showing why, in those situations, concealing coloration is almost or quite a negligible factor in the lives of birds and mammals. In very many forests, for instance, there are just the millions of outlines, vistas and colors which he describes and also the interposed foliage and twiggery, and this, and not any pattern of coloration, is the main reason why in such forests the spotted jaguar and monochrome cougar are equally hard to see, why the beautifully striped and tinted bongo and the dark monochrome forest hog are equally difficult to get, why, in other forests, small birds of every conceivable pattern are equally safe and equally exposed to danger. In other words, in many situations in nature, the character of the surroundings is such, that the animal's coloration is of no moment one way or the other, if it is able to take advantage of the surrounding cover; and there are other situations which are such that the question of coloration, whether concealing or revealing, is of entirely secondary importance, although it probably counts somewhat. It would be impossible to show more clearly than Mr. Thayer in the quoted sentences has shown, why his own theory has, as regards many birds and mammals, no foundation in fact.

There are however other large classes of birds and mammals, which have advertising coloration-patterns, and which live under conditions that are erroneously described in the sentences just quoted from Mr. Thayer. The big antelopes of the plains, both the prongbuck and the African antelopes, the birds of the ocean and the barren islands like guillemots, fulmars, gulls and puffins, the birds of the flats by river and lake, such as most herons, ibises,

storks and pelicans, and the smaller birds of the meadows and pastures and scattered woodland which live usually above the grass tops, such as the crows, grackles, shrikes, bluebirds, kingbirds, are examples of these classes. They do not live amid the "complexity of millions of outlines" and colors and vistas with foliage and twiggery intervening. They pass their lives for the most part against simple and uniform backgrounds, backgrounds against which a wildebeest or a gull or a heron or a blackbird stands out prominently. These animals are not shielded by cover, and when, as is often the case, their coloration patterns are really advertising there is nothing in the surroundings to minimize the effect of this advertising quality. Here all we can say is, first, as to actual facts; that hundreds of species living under these conditions have coloration patterns of advertising quality; and second, as a matter of belief, that evidently in the evolution of these species the possible advantages of a concealing coloration have been so far outweighed by other aptitudes, physical and mental, that concealing coloration as a factor has wholly dropped out of their life schemes. It thus appears, first that there are multitudes of species of birds and mammals living under conditions which conceal or blur the outlines and colors of all these birds and mammals, and thus render concealing and revealing coloration patterns alike of little account; and, next, that there are multitudes of other species living under conditions which permit their advertising coloration really to advertise them, but which have developed aptitudes and characteristics which in their turn render the question of revealing or concealing coloration a matter of indifference as far as the perpetuation of the species is concerned. In the first case the physical surroundings are such as to minimize the quality of either concealing or advertising coloration; in the other case, the surroundings emphasize the quality of the advertising coloration, but its effect is rendered null by the traits and aptitudes and manner of life of the animal.

In his paper on 'The Influence of Physical Conditions in the Genesis of Species'[1] Mr. Allen has, as it seems to me, shown that in many geographical areas, often of large size, a multitude of species are affected alike, as regards various physical characters, including coloration, not by the selection of individuals for survival, but by the direct action on all the individuals alike of the conditions of life.[2] He shows that this is in all probability the case as regards the general gray tints of the birds and mammals of the semi-arid

---

[1] Radical Review, Vol. I, pp. 108–140, May, 1877; reprinted in Smithsonian Report for 1905, pp. 375–402 (1907).

[2] I need hardly say that as regards almost all these questions Darwin himself wrote with sanity and caution, even where more ample material and more ample investigation have proved some of his conclusions to be erroneous; it is among his followers that we find the unwarrantably extreme positions.

regions of the United States, and the heavy dull colors of those dwelling in the humid northwest; and Selous calls attention to the similar conditions obtaining in South Africa, as regards, for instance, zebras, quaggas, and blesbocks. But of course there are many exceptions to any such rule. Among the birds of the semi-arid regions the distinctive markings of the males in breeding plumage are often as deep and vivid as elsewhere. A more striking exception occurs in the arctic and sub-arctic regions. In these boreal lands, even the most unobservant are struck by the fact that most birds and mammals are largely or entirely white, either all the time or in winter. But the musk-ox and the raven, and the wolverine as far north as it extends, remain as dark as elsewhere, under conditions that give their coloration the most intensely advertising effect. It is said that the raven may only be a comparatively recent immigrant into the polar regions, having followed the whalers; this is probably not so, but in any event the raven has always been an inhabitant of Scandinavia, Finland, the Barren Grounds and Labrador, where like the wolverine, the black-coated creature has lived for ages side by side with ptarmigans, gyrfalcons, white foxes, white wolves, arctic caribou, boreal rabbits, and ermines, without showing the slightest tendency to share their general type of coloration. The wolverine's range overlaps that of the white wolf and white fox, and is on the average more boreal than that of the white weasel;[1] if the white is a benefit to the wolf, fox and weasel, then the black must be a harm to the equally carnivorous wolverine. Wolves feed on musk-ox calves just as much as on caribou; if the white is protective to the latter, then the coloration of the former is damaging to them. If their color helps the snowy owl and gyrfalcon, then the raven is harmed by his. As a matter of fact, however, the four carnivorous quadrupeds spoken of all hunt primarily by scent, and their eyes are such that if at all close they can see their prey move no matter how it is colored; and therefore concealing coloration plays no part in serving either the beasts of prey or their victims. As to the birds of prey, I have already shown that their coloration neither has, nor can have, any effect in either helping or hindering them while hunting.

Mr. Thayer particularly mentions marine mammals, whales, as equipped with a "fully developed obliterative shading of surface colors." If he had turned to such a book as 'The Marine Mammalia,' by that fine old hunter-naturalist of the high seas, Captain Scammon, he would have realized that it is quite impossible to make any such assertion about whales, porpoises and dolphins. Closely allied species and even the different sexes of the same species have utterly different patterns of coloration. There are species

[1] That is, the white weasel goes farther north than the wolverine but also much farther south.

that are white all over, others that are black or brown all over, others that are black above and white or whitish beneath, and yet others that are black with strange white or lavender markings across the back as well as below. Yet nothing has been shown to warrant any belief that these markings indicate difference of habits. If the white bellies render some of the whales and porpoises inconspicuous, then this simply means that the black bellies of other whales and porpoises are advertising. Either way the result is fatal to Mr. Thayer's theory; and as a matter of fact all the probabilities are that neither type of coloration has any effect in concealing the animal from its foes or its prey.

Size and Coloration in Mammals in Relation to Conspicuousness.

Failure to remember the effect of mere size upon our eyes necessarily causes us to misestimate the qualities that tell for or against any given animal. Thus, Mr. Thayer states that ordinarily bears are not obliteratively colored, and adds that they are too big and powerful to need defensive coloration, and are also nocturnal. (As a matter of fact they are usually less nocturnal, when dwelling in regions remote from man, than most other carnivores; certainly they are no more nocturnal — Mr. Thayer's statement being one of the innumerable instances of his recklessness in unconsciously manipulating facts so that they fit his theory.) But there are many small mammals that are colored like bears; minks, for instance, and wolverines, fishers, and even sables, and the same is practically true of mole shrews and many meadow mice and even some marmots. These are no more obliteratively colored than are most bears, and if they were as large as bears and lived in the same places, they would be just as easy to see. When bears live in dense brush or tall grass or among thick forests hunters find it extremely difficult to get them; and this is true even of the glossy black bears of the hardwood forests of the eastern United States. Even Mr. Thayer admits that their coloring is not obliterative or concealing; and when, as is generally the case, they are hard to see, it is because of the thick cover in which they live and because of their wariness. If meadow mice or marmots were as big as bears they would be almost or quite as conspicuous; doubtless they seem more conspicuous to weasels than bears do to us; and when above ground they escape observation, just as bears do, because they live in thick cover — cover, which relatively to their size, is far more sheltering than that in which bears usually live. Of the species and varieties of Rocky Mountain woodchucks many are colored substantially like the various silver tip, cinnamon, and brown bears, and, relatively to their size, are at least as conspicuous; they are wary, their shrill alarm whistle being one of the common sounds of the mountains, and when they crouch they are hard to make out among the boulders and small rocks;

but their coloration is no more concealing or protective than that of the bears. The meadow mice and mole shrews spend most of their time in burrows or in tunnels under the grass and leaves; but I have often seen them in the open, and they are then for their size, and according to their surroundings, just as conspicuous as bears; for when a meadow mouse is not moving it always squats and then all the effect of the very slight countershading vanishes. They do not owe their concealment to obliterative coloration, but to their habits and to the density of the cover in which they pass their lives. The all importance of cover and habit, as compared to coloration, in the lives of meadow mice, is shown by their extreme reluctance to leave the cover of the grass and venture on bare ground. The mice will often destroy the trees in orchards, and nurseries, if matted grass or snow is left around the trunk; but a cleared, hard space of only 18 inches will create a barrier which the mice will not pass. It would be impossible to get more convincing proof of the vital importance of cover to the meadow mouse and the comparative and probably absolute unimportance of coloration.[1] Among the species of mole shrews and meadow mice, are some which in multitude of individuals surpass all our other mammals, except possibly the white-footed mice. They swarm in such numbers that probably they equal the number of all other species of north temperate American mammals put together. In other words, over half the individual mammals of America are either not protected by obliterative "concealing" coloration at all, or only to the insignificant extent that bears are protected, and owe their immunity from harm to their habits and surroundings. When these meadow mice, mole shrews, cotton rats, pocket mice, and other similarly colored small creatures, crouch motionless, and thereby escape observation, they are not countershaded at all. At the Bronx Zoo some cotton rats are kept in an open cage in the snake house; by glancing at them, in their ordinary attitude, anyone can see that in this ordinary attitude there is no countershading of their coats and that so far as their coloration does tend to conceal them it is not because of countershading, but because their dull coloring is inconspicuous and makes it difficult to pick them out among their ordinary surroundings. These mice and shrews always squat when they are not moving.

But this is not all. I have assumed that Mr. Thayer is right and that bears (which, as he properly says, are not obliteratively or defensively colored) and those woodchucks, meadow mice, and mole shrews which are colored, as regards tint and shading, like bears, are less obliteratively, or defensively concealingly-colored than those animals which, like deer, cotton

[1] See Ernest Ingersoll's 'Animal Competitors.' Some species like the pine mouse live in burrows and are nocturnal so that their coloration is of no effect either way.

rats, kangaroo rats, white-footed mice, true shrews, weasels, and the like, shade from dark above to clear, brilliant white, or, more rarely yellow or fulvous, below. But this assumption is contrary to the truth. In their normal and ordinary surroundings, and under the conditions of their normal and ordinary lives, the brilliant white of these latter animals, when visible, at all, always has an advertising and not a concealing quality. If a bear were colored like a weasel or a black-footed ferret, it would be rather more, and not rather less, conspicuous than it is now. It is only the difference in size between the animals that prevents us from seeing this. The weasel's upper-body coloration is concealing only as a bear's is; and the bright lower parts make it more and not less conspicuous. It is the weasel's stealthy, silent, snake-like progress, its caution, and its extraordinary agility and speed, and the cover in which it is found, that make it invisible. The small white-bellied rodents and shrews are inconspicuous not because, but in spite of, their white bellies, and especially because when motionless they crouch so that the white is hardly visible. One night-fall in the late dusk, I saw two white-footed mice in a big bush; apparently they had come out of an old bird's nest. As they climbed among the twigs, I could place them only by the glint of the white bellies (I once noticed the same thing with a flying squirrel). The white underparts had an advertising effect. A bear with white underparts would be more conspicuous than he actually is; that is, he would be slightly more conspicuous than at present if he were colored like a white-footed mouse instead of being colored like a mole shrew or meadow mouse. The little rodents in question escape observation if within ken of vision only when they squat motionless; they then always lose most and generally all, of the effect of countershading, and the white is not seen.

It thus appears that the large majority of our mammals in point of species, and the immense, the incalculable majority in point of individuals — that is, the small rodents, insectivores, and carnivores that live on the ground, whether in the forest or the tall grass,— are in all probability in no way dependent upon countershading for concealment, and it is certain that if the countershading does play any part at all in their concealment, it is a wholly insignificant part. If they have white upon them, this color, when seen at all, usually has an advertising, and practically never a concealing, effect. Many of these species, like the white-footed mice, are nocturnal; and as regards these the coloration has almost no effect one way or the other. The brilliant white underparts have on the whole an advertising quality; but this is unimportant for when the animal is motionless it squats, so that instead of the white belly concealing (or revealing) the animal, the animal conceals the white belly; and if the animal is nocturnal

the precise hue or shading of the upper parts can be of no effect. So far as the coloration of these little creatures has any concealing effect at all it is due to its harmonizing with the surroundings — the sticks, stones, patches of bare earth, grass, dead leaves, lights and shadows — and not to any countershading, or any obliterative quality dependent upon countershading. But it is not certain that the color has any great effect in concealing these animals; at any rate, the species include animals colored orange, russet, dark plumbeous or blackish, gray, and brown of many shades; some of them are nearly uniform in color, others have white bellies; all seem equally hard to see, and seem to thrive equally well. The probability is that each of these little animals owes its escape from the vision of any foe purely to its remaining motionless among surroundings such that any small motionless object of almost any color (aside from the very brilliant colors) is exceedingly difficult for the eye to pick out. As soon as the little animal moves it becomes visible to its keen sighted foes. Hawks and owls have eyes so keen that they are doubtless attracted by the slightest motion; they do not trust to scent, and rarely pounce on a mouse or shrew that is not moving. Foxes, as I have myself seen, sometimes listen for a mouse's squeak, or watch for and pounce on one when it moves; but they also scent them. Weasels almost always follow by scent, on the open ground or through the runways, tunnels and burrows. Against weasels and foxes the coloration is probably of no consequence as a defence. The weasel follows the quarry by scent until almost upon it, and as soon as it moves the weasel instantly sees and seizes it, the murderous skill, agility, and eyesight of the marauder being such that the quarry has no chance. The final rush or pounce is made by sight, but the quarry is then in motion, and its "countershading" and "pattern of coloration" have ceased to be of the slightest use for defensive purposes. A man can hardly put himself in such a position as to be able to imagine just how the little animals hide from, or are discerned by, their foes; but he can get a fair idea of the relative parts played by scent and by sight in their pursuit by thinking of his own experience in hunting bear and deer in thick forest or other similar cover. On the open plains of short grass or among bare mountains, the rifleman may safely rely only on himself. In thick forest hounds improve his chances a hundred fold, simply because they can always scent the game and follow it, while he rarely gets even a glimpse of it until it is roused by the pack and on the run, when he has no difficulty in seeing it. The nose plays a far more important part than the eye, up to the last moment. The glossy pelt of the black bear is very conspicuous, but in forest cover, color counts for so little compared to other qualities that a bear is less often seen than a deer. A white-footed, white-bellied mouse or a white-bellied weasel is for its size as conspicuous in point

of coloration as a black bear, and more conspicuous than a brown bear; each eludes observation in thick cover for substantially the same reasons as in the case of the bear; and (keeping the element of size constantly in view) neither is normally more difficult to observe among twigs and leaves than is a bear which lies motionless among stumps and timber. Most of the small animals that live in the forest, and in the meadows in and under the grass, owe their invisibility primarily to the cover in which they live, to their nocturnal habits, to their clinging to their burrows; probably some of them are helped by their coloration; but very many of them are certainly no more helped by their coloration than a black bear is by his.

The element of size makes it so very difficult for us to tell how conspicuous or inconspicuous small mammals are, that it is well worth while for us carefully to consider the quality of conspicuousness in game animals, which stand to us in point of size much as mice and hares stand to weasels and other small carnivores. I shall speak not only of American big game, but also of African big game animals, because in number of species and individuals they surpass those of all other lands.

In North America the bison and musk-ox are colored substantially like the bears; so is the moose. In all three the coloration is substantially advertising rather than concealing. There is no effect of countershading. The habitat of the musk-ox is such that it can never escape observation when once within the range of vision of its foes, and the same was true of the bison of the plains. The bison of the woods is sometimes hard to make out in its habitat merely because of the denseness of the shadows and the thickness of the cover. The moose is very conspicuous if in open country or along the edge of a stream or pond, its usual summer haunts; if in thick woods it is hard to make out for the same reasons that make the wood bison — or any other animal — difficult of observation under such circumstances; and it often stands motionless when slightly alarmed, and occasionally does so when wounded and followed up. But on the whole, its black bulk, if it can be seen at all, is more apt to attract than to elude attention; and it trusts only to its wariness, its keen senses and the cover in which it dwells for safety. The white goat is an extraordinarily conspicuous animal all through the summer months, and even in winter it is quite conspicuous, as the cliffs among which it dwells are rarely completely snow covered, and the black horns and muzzles make points of dark which can be seen a long way. On the whole its coloration has a highly advertising value. The wolves, cougars, and other carnivores which occasionally prey on it, are probably not helped by the white goat's coloration except in the case of the kids. But it certainly does seem as if the highly advertising coloration of the kids must put them at a disadvantage in the presence of eagles and four-

footed carnivores. Apparently the goats trust purely to their truculence and watchfulness, and to their climbing ability, and the inaccessible nature of their haunts, for safety; and I may add that, as against human foes, goats seem as deficient in wariness as they are in concealing quality, the difficulty in approaching them being due almost solely to the physical circumstances of their surroundings.

The bighorn, on the contrary, in the United States at least, as well as in Mexico, is colored much like its ordinary surroundings. Its coat harmonizes well with the rocks and clays of the mountains and badlands. I doubt whether the countershading of the coat has anything to do with this concealing quality, for the sheep are more difficult to make out when lying down than when standing up, and they often lie down with outstretched necks when consciously hiding; this being the attitude of the young lambs. Doubtless the concealing quality of their coloration is of chief use in the case of the young lambs, the older sheep seeming to trust almost entirely to their wariness, and their sharp senses for safety, and not to escaping observation. The light rump patch is much the most conspicuous feature about the bighorn, and practically always has an advertising quality. The far northern species of sheep is white; this tends to conceal it in winter, but renders it very conspicuous in summer; the lambs being as conspicuous as the white goat kids, at the very time that a concealing coloration would be of most use to them.

The pronghorn antelope has an advertising coloration as marked as that of the white goat itself; and in its case I am inclined to think that the advertisement is sometimes conscious and deliberate. I cannot be sure of this, for the hairs of the white rump patch are erected in chrysanthemum fashion whenever the beast is alarmed, excited or interested. But when herds of antelope feed into sight of one another, at a distance of a couple of miles, I have seen the rump patches on both sides flash into dazzling white in a way suggestive of signals or recognition marks. The advertising marks on the prongbuck are not confined to the rump; the white and dark bands of the head and throat are conspicuous; but the white rump patch is one of the most conspicuous marks worn by any wild animal. It is practically never obliterative or concealing; it is always highly advertising. Mr. Thayer has asserted the contrary, and attempts to show it by picturing the animal in a straight stern-on-view, with the rump above the sky line, and everything else below. This picture is wholly misleading. For once that a wolf or cougar catches its first and only glimpse of a prongbuck in just such a position, where the rump (if the sun happens to be in a given quarter of the horizon) is obliterative, there are probably a thousand or ten thousand cases where the animal is in some other position, and where the rump is

advertising. Unless nearby, the difference between the level eyesight of a wolf and cougar and of a man would be of no consequence, a fact known practically to every hunter or observer; for in looking for antelope such hunter or observer is most apt to be crouching or lying down, with his eyes as low as those of a wolf or cougar, and yet he is just as sure to see his game when in such a position as when standing erect. Moreover the antelope country is usually slightly rolling, and not dead level, and the antelope are not apt to be seen against the sky line; and if seen except against the skyline the rump becomes advertising; again, the animal is of course, in accordance with the doctrine of chances, much more apt to be seen standing sideways or quartering than exactly rear end on, and except in the latter position the rump could not obliterate the body; and as the beast of prey would be moving the chances are infinitesimal that in an advance of a few feet he would not get into a position where the rump patch would cease to become obliterative and would probably become advertising. Again, even against the sky line the rump is always advertising at night, and most beasts of prey hunt at night. Finally Mr. Thayer's theory shows complete ignorance of the habits of the prongbuck. The adult prongbuck, like almost all the game of the open plains, trusts for escape from its foes solely to vigilance, eyesight, and speed, never to stealth or to escaping observation. When on its feet it rarely stands motionless, and never for any length of time, and of course absolute immobility for a considerable period would alone give Mr. Thayer's theory any, even the smallest, chance to be realized in practice. Pronghorns are motionless for any length of time only when they lie down. Sometimes they lie down in exposed places, evidently still trusting to their vigilance for safety; but I have also seen them lie down in hollows, or in long grass, where it really was difficult to see them at a distance. When lying down the effect of the white of the rump almost or quite vanishes. The fawns try to escape observation by lying flat on the ground with outstretched head, the white shown being at a minimum. Thus the most elementary study of prongbucks amid their natural surroundings shows that there is not even the smallest foundation for Mr. Thayer's theory. The white rump is a striking instance of purely advertising coloration. It is usually what first catches the eye when an antelope is within ken of vision; and it is often seen distinctly long before the rest of the antelope is visible.

In most forms of the caribou, the coloration is at least as much advertising as concealing. The caribou trusts to its senses and vigor, and not to concealment, for protection. The vast majority of caribou are found in the open; the woodland caribou are difficult to make out in the woods merely as all animals, whatever their color, are difficult to make out in cover.

The wapiti does sometimes try to hide. On such occasions I have seen

the huge beast lie motionless on the ground, with outstretched head, as if it were a fawn. It also at times, when in thick forest, endeavors to escape observation by standing still or sneaking stealthily away. Normally it trusts for safety solely to vigilance and flight, and makes no effort to conceal itself. Its coloration is rather conspicuous in the open; in woods it has not much effect, the animal when hidden owing its concealment chiefly to the thick cover and deep shadowings, as with the moose and wood bison, although helped by the monotone of a coloration which is neither black, white, nor vivid red. The light patch on the rump is never of concealing or obliterative value; it is conspicuous, and is often the first thing about the beast to attract attention; it is on the whole an advertising mark. The theory that it is ever, under any circumstances, of use to the wapiti by misleading some beasts of prey when about to spring on it, is too ridiculous to need attention. Wapiti calves, like the young of all other deer, and indeed of all or almost all other ruminants, crouch flat and motionless. In sum, I should say that the wapiti, in spite of its size, possesses a coloration which in the woods may have on the whole of a very slight concealing value, except the light rump patch, which is usually advertising; but it is not countershaded, the dark legs and throat and belly hairs indeed making the back appear lighter than the under parts. It thus appears that the wapiti, which does sometimes trust to concealment, and may be slightly helped to this end by its coloration, lacks the countershading on which Mr. Thayer puts such stress. Evidently the presence or absence of countershading is of no consequence in such a case, and a monochrome coloration, even on a very big animal, may assist the animal to escape observation, if the animal by its actions shows that it can take advantage of the coloration; although even in this case the coloration is of utterly insignificant importance compared to habit and cover in helping it to elude the observation of its foes, while its scent, wariness and speed are the prime factors in its preservation.

The common blacktail deer lives largely in ground where it trusts to its vigilance, sharp nose and eyes, and ability as a runner and climber, for protection. But in some of the Rocky Mountain forests, it lives much like a whitetail deer; and even in the open country it lies in cedar thickets and cover-filled ravines, where it crouches motionless to escape observation. In such spots it is hard to see, but this is chiefly due to the thickness of the cover. Ordinarily the white rump has an advertising value, especially when the deer is standing; but when motionless, and striving to escape observation, the deer is generally lying down. When thus lying down there is little or no effect from countershading; the deer is inconspicuous simply because the hide that is visible is of a neutral tint, and because the cover is thick and there is a medley of colors and shadings, in which any pattern

of coloration — short perhaps, of some vivid black, white, or red or pied — would be inconspicuous. Mr. Thayer's theory of the all-important effect of countershading is worth considering in connection with the relative conspicuousness of the wapiti and the blacktail. The blacktail in some of its forms is slightly countershaded (at least when seen sideways), the wapiti is not; but a careful study of the animals in the wilds fails to show that this has any effect one way or the other on their conspicuousness; the wapiti is bigger and darker and therefore more easily seen as a rule, although the white rump of the blacktail attracts attention at a great distance.

The Columbian blacktail is, as regards this matter, substantially in the class with the blacktail; in the American Museum the mounted Sitka deer is really inversely countershaded, thanks to the black hairs on the chest, while some of the mounted Rocky Mountain blacktail, or mule deer, show no countershading whatever.

The whitetail is of all American cervines the one in the life of which concealment plays the biggest part. Given equal conditions, as compared with any other species, the whitetail is on the whole hardest for the hunter to find and see. Its power of concealment is greater than that of any of its fellows, and for this reason it tends to outlast them all. Yet its coloration is less concealing than theirs, and has on the whole a greater advertising value. As compared with the wapiti, for instance, the whitetail's coloration is less concealing, in spite of its countershading; but its smaller size, the dense cover in which it usually dwells, and its stealthy skulking ways, more than offset the brighter and more conspicuous coloration, and make it more difficult to see than the wapiti. The winter coat of the whitetail, the so-called "blue" of hunters, is not conspicuous, especially in the usual surroundings of the northern part of its range. But the bright red summer coat is conspicuous, especially against the bright green of the grass, brush and underwood amid which it dwells. It is almost as conspicuous as the glossy coat of the eastern black bear. Moreover the pure white belly, and the flaunting white tail, are very conspicuous. Its summer coloration is not concealing, but advertising, especially in its normal surroundings; while the upright carriage of the spread tail, the "flag," when interested, excited or alarmed makes it an almost startling advertisement mark. It is then a striking example of what Mr. Thayer calls the "rear-end sky pictures" which he says "obliterate fleeing deer, antelopes, hares, etc." Mr. Thayer — without a particle of proof, and evolving his theory out of pure guess work — says that these rear-end sky-patterns are "most beneficent to the hunted beasts," especially at night because their enemies look upwards at them, and are so confused by the white stern blotting out the fore-shortened body as to miss their spring. The first answer to this

theory is, of course, the sufficiently obvious one that at night white is not normally a sky color, and so that these white stern marks are *not* "sky pattern marks" at the very time when, according to his theory, they serve as such. They are advertising marks; for once that they would puzzle the hunted animal's enemies, as Mr. Thayer supposes, there would be scores or hundreds of instances in which whatever effect they had would be to render the quarry a little more evident to the hunter. The attacking cougar or wolf is practically on a level with the "sky picture" in question; he is at least as apt to look at it from a level as from below. I have lived in regions where I have seen the carcasses of hundreds of deer, and a score or so of antelope and wapiti, that had been killed by cougars and wolves; in most cases snow was on the ground; in no instance was there the slightest evidence of anything having happened like what Mr. Thayer supposes, nor have I ever heard of such an incident occurring. Mr. Thayer's theory on this point is a pure guess, advanced without a particle of proof, utterly unwarranted by any facts I have ever observed, contrary to all observed facts and to all probabilities, and, as I believe, on its face without even the smallest foundation or justification. The whitetail is an animal of the forest, and so, whether the cougar or wolf looks up at him or not, the white rump and tail are in the great majority of cases seen not against the sky, but against trees or brush, and so become advertising.

The pure white belly so far as it has any effect at all — which is very slight — is always advertising, not only in summer but in fall and spring, and in winter when there is no snow. It does not "finish the general effect of the countershading of the back and sides," but appears, when the animal is sideways to the observer, as a vivid white line, contrasting strongly with almost every background. If possible, however, the animal crouches flat in order to avoid observation and in such position the effect of the white is minimized; when it stands motionless or steals noiselessly through the bushes, to avoid being seen, the head is held low and the tail is tight down. The fawn is brilliantly spotted. In certain lights these spots render it inconspicuous. Of course when this is the case it necessarily means that, under the same conditions, the unspotted coat of the mother is conspicuous — it shows how great is the need of common sense in considering these matters that it is necessary to point out the obvious fact that if spots tend to conceal an animal, then the absence of spots tends to reveal it. The bright uniform red coat of the doe and the brilliantly white-spotted red coat of the fawn cannot both be concealing. Perhaps neither is; but if either is, it is that of the fawn — and if this is so and if, as is probable, the coloration of the fawn represents the ancestral coloration of the adult, then we develop the curious further fact that the deer

has actually lost the concealing coloration it once possessed, a sure proof that such coloration was of no consequence in its life. The fact seems to be that the whitetail in its summer coat owes practically nothing in the way of concealment to its coloration. In June, when the young are nearly helpless, whether in the Louisianian swamps and cane brakes, or in the hardwood forests of Pennsylvania and Virginia, the coloration of the whitetail is almost as conspicuous against the vivid green of the undergrowth, as is the coloration of the black bear; and this is at the very time of the year when it is most important for both animals to be concealed. Yet as a matter of fact both animals *are* concealed, and this for the simple reason that the haunts and habits of both animals are infinitely more important in working for their concealment than their coloration could be. The natural foes of the old and the young deer, and of the young bears, trust far more to nose than to eye in finding them — any owner of a pack of hounds will realize this; and where the cover is dense, and therefore where there are all varieties of light and shade, and strong color contrasts, any animal which keeps still, which is wary, and which moves stealthily, is exceedingly difficult to see. Any hunter knows how extraordinarily difficult it is even to catch a glimpse of a deer or bear when he is hunting, unaccompanied by hounds, in dense forests of great extent; and when this is the case with the large animals which are strikingly colored, it ought to be easy to understand that the difficulty of seeing small beasts in the same woods is due, not to their coloration, but chiefly to the simple fact that they live in cover so dense, and amid surroundings so varied, as to tend to conceal any small animal of practically any coloration.

How little countershading amounts to one way or the other, in helping conceal an animal is vividly demonstrated by a study of the life habits of these deer. Compare, for instance, the moose and wapiti, both of which are inversely countershaded, so to speak, that is both of which as a rule appear darkest below and lightest above, with the blacktail and whitetail, both of which are countershaded. The wapiti often tries to escape notice, not only by skulking but by lying flat, just as the smaller deer do; and his lack of countershading does not interfere in the least with this attitude on his part. Usually he dwells in substantially the same kind of country as the blacktail, and here his superior size and dark color make him more conspicuous, and he vanishes before man quicker than the blacktail (though he holds his own rather better if anything when the only foes are wild beasts). But in summer his coat has a much more concealing quality than that of the whitetail, when both are in thick cover; although the fact that the whitetail is such a finished skulker, and dwells in such thick cover, enables it to outlast the wapiti in the presence of man. The moose, because of its wari-

ness, but above all because of the thick cover it loves, will outlast both the wapiti and the blacktail in the presence of man. A hundred and fifty years ago there were probably many more wapiti than there were moose east of the Mississippi; now the wapiti have vanished and the moose still remain. Fifty years ago there were many times as many blacktail in Dakota as there were moose in Maine; now the moose in Maine probably outnumber the blacktail in the Dakotas. The countershading on the smaller deer is not of the smallest benefit to them, the white beneath having an advertising effect; and the lack of countershading on the moose and wapiti has not been of the smallest harm to them. The fact that the moose's coloration and the whitetail's summer coloration, are on the whole advertising, does not harm them in the least, because they lie in thick cover and know how to use it to the best advantage. On the whole, it is safe to say that the coloration of these deer is of small consequence, perhaps of none, and the countershading of certainly none, so far as yielding them concealment or protection is concerned. Now, what is true of these big animals in the presence of wolves and cougars is in all probability true of rabbits, woodchucks, ground squirrels and mice in the presence of foxes, bobcats, and ferrets and weasels.

The Texas peccary has a dark although not very conspicuous median back line; but it is not really countershaded; and the mounted group of Mexican peccaries in the American Museum show that these animals are in certain forms really inversely countershaded. The peccary's coloration is if anything slightly revealing; but I do not think that it really has much effect, one way or the other, in concealing or revealing the fierce little hog. It sleeps and rests in holes or hollow logs, or other such places, where its coloration is of no consequence; and when it moves abroad it goes in small troops, which make no effort to hide, and as a matter of fact must be readily observed by all possible enemies, for some members of the troop are always in motion. Peccaries trust for defence chiefly to their truculence and their power of concerted action.

The cougar is an interesting beast from every standpoint, including its coloration; and a study of the effect of its coloration from the "concealing" standpoint is, or at least ought to be, illuminating, when taken in consideration with much that is written about the concealing quality of the coloration of leopards, tigers and other cats. My experience, in accord with the experience of almost all other hunters and outdoor naturalists, is that the cougar is of all our American big animals the one most difficult to see and most rarely seen. The cougar's neutral-tinted, nearly unicolored, countershaded coat, unquestionably has a concealing quality, in the woods and among clay banks and rocks under ordinary conditions; and for a long time I,

in common with most observers, accepted this as the chief element in explaining the way in which the cougar escapes observation. But when I came to think out the matter I realized that in many parts of its range the landscape is in winter snow covered, and that a totally different theory must be invoked to account for the cougar's invisibility when snow is on the ground. I have spent some time where cougars were common, both in the Rockies and on the Little Missouri; in both places, but especially in the Rockies, the winters were long and there was much snow. The country was not thickly forested in the regions where I came across cougars or their sign, except on Clarke's Fork, and in parts of the Yellowstone Park. Elsewhere in the Rockies, where I penetrated their haunts, they lived in a land of mountains and hills covered sparsely with piñon and cedar, and with thick timber only in patches in the ravines. In the Bad Lands the cover was still more scanty and the patches of dense cover still fewer and smaller. It was always good blacktail country, and usually good wapiti country, and there was never difficulty in finding either of these animals while they continued in the land. But the cougars who preyed on them were invisible. Sometimes they were trapped, and they were readily found and killed with trained hounds; but the still hunter came across them very rarely. Hardly any of the numerous professional hunters I knew had come across them more than two or three times in the course of many years solitary hunting. Now, the fact to which I wish to call attention is that this was just as true in the winter, when the landscape was snow covered and the cougar's coloration could have no effect in concealing it, as at any other time. Occasionally a hunter tracked a cougar in the snow; but except as a result of tracking the cougar was not more often seen in winter when its color was advertising than in summer when its color was concealing; and yet this was in regions where the cover was comparatively sparse, and where in consequence it was possible continually to see wapiti and blacktail (whereas in regions of as great extent but thickly forested the deer also would have been practically invisible). This means that the cougar's coloration was really an insignificant and practically negligible factor in its concealment. The prime factors in keeping the cougar invisible were its nocturnal habits, its caution and wariness, its sharp senses, its wonderful ability to take advantage of even the scantiest cover, and its power of lying indefinitely motionless and of advancing with inconceivably noiseless and crouching stealth.

It seems to me that this side of the cougar's life history has an important bearing upon several problems connected with concealing and advertising coloration. The cougar is equally at home among the Rockies and Andes, in bare broken plains with scanty cover, in cold northern pine forests, and

in steaming tropical forests and jungles. In lands of thick cover and lands of scanty cover he is almost equally invisible; so his case is not parallel with the cases of the black bear and whitetail deer, which owe their invisibility principally to the thick cover in which they dwell and are almost or quite as visible as the grizzly and the blacktail when they live in open country. He is no easier to see in places where for months the landscape is snow covered than in jungles where there is never any snow. It is evident therefore that as regards concealment he owes practically nothing to his coloration and everything to his habits and attributes. This explains at once why spotted leopards and jaguars and striped tigers are no more and no less apt to be seen than black leopards and black jaguars; why the jaguar (colored precisely like the leopard) is no more and no less visible, in the same surroundings, than the mono-colored cougar; why in South America mono-colored cats of several kinds, and spotted and variegated cats of various kinds, are all equally hard to see under the same conditions, although if the coloration of one kind is concealing the coloration of some of the other kinds cannot be. The truth is that the habits and attributes and ways of life of the various cats constitute the prime factors in their invisibility, and from this standpoint are so infinitely more important than the coloration that it is difficult to say whether the spotted or striped hides, or the merely uniformly black or tawny hides, really have any appreciable effect one way or the other as regards either concealment or advertisement.

Furthermore the facts in the case of the cougar, an animal big enough to permit us to be certain just what the facts are, enable us to appreciate the real conditions which render it difficult to see so many smaller creatures. The dark brown, or black, nearly unicolored mink, the red-brown, white-bellied weasel, the light bodied, black-footed ferret, have utterly different colorations, and yet all flourish and all are rarely seen. The mink has almost no countershading, the black legs of the ferret make it really countershaded the wrong way, the countershading of the weasel results in giving it a conspicuous white throat and belly; the three types of coloration cannot all be concealing, and probably no one of them is — indeed they can almost be called advertising. Evidently the three animals owe their comparative invisibility, the rarity with which they are seen when compared with squirrels and rabbits, entirely, or almost entirely, to their habits and traits, to the speed and yet gliding stealth of their movements, to their wariness, their supple ability to take cover, and their liking for darkness. Probably the same statement would apply to many species of mice and shrews, including all those that are nocturnal or that show much white. In the case of multitudes of these smaller creatures which are rarely seen, it is probable that their coloration either plays a wholly minor part, or no part at all, in keeping them concealed.

The lynxes stand substantially in the same class with the cougar.

The gray fox has a coloration which may possibly be slightly concealing; but the coloration of the red fox, including the cross and black foxes, is highly advertising, the animal owing its safety purely to its habits, its astuteness and its sharp senses. The red form of the red fox is slightly countershaded; the cross fox is inversely countershaded, being black below, as is shown in the mounted specimen in the American Museum; but the two forms are equally successful in life, and are equally conspicuous, the countershading having no effect one way or the other; and the conspicuous coloration is of no consequence because the fox relies exclusively on its cunning, wariness, sharp senses and physical address, coupled with ability to dodge through, and to take advantage of, cover. The coyote is one of the very few mammals where the countershading really does sometimes reduce the animal's visibility, even when it is standing up, a long distance from the observer, in its ordinary haunts on the plains; I am inclined to think that its color and its countershading combined really may at times be of some use to it. But I am by no means certain that this is the case, because of what is true as regards its bigger brother the wolf. In some of its forms the wolf is colored much like the coyote; but in various places white wolves, red wolves, and black wolves are or have been as plentiful as the gray or brown wolves, evidently thriving as well; and the coloration of the white wolf of the western plains and the coloration of the widely distributed black wolves, which are found in Florida as well as in the sub-arctic forests, are both highly advertising. Evidently the color of a wolf's coat, and its countershading, have no bearing on the wolf's success in catching his prey or evading any possible foe, his habits and traits being such that the concealing or advertising qualities of his coloration have no result on his welfare; and where this is evidently true of the big wolf it may also be true of his smaller brother.

In Africa I was able to study for nearly a year the habits of the teeming myriads of great game, and many of my observations were made with special reference to this question of concealing coloration. The first, and by far the most important, fact brought home to any competent observer is that as regards the great majority of these animals the question of cover infinitely outweighs the question of coloration in the problem of concealment; this being so true that when there is no adequate cover most of the big animals do not trust to concealment at all, and concealment, whether of coloration or otherwise, plays no part in making their lives successful. Next comes the fact that there are some animals, chiefly the cats, whose peculiar physical address in hiding and in stealthy approach and escape is such that their ability in this respect far outweighs the question of colora-

tion, and even the question of cover, provided the cover is in any way adequate. Finally, there are some animals as to which it is possible that the coloration does have a concealing effect of some importance.

The game that dwells in thick cover is extremely hard, not merely to shoot, but even to see; and it is the cover, and not the coloration of the animals, that is responsible for this. Indeed mere size seems to have a far greater effect on visibility than does color; the bigger the animal, the easier it is to see. But sufficiently heavy cover shields even the heaviest game. In the high elephant grass, and in bamboos, as well as in dense forest, elephants disappear so completely that they can only be procured by following on their trail, and even their giant bodies, looming black and large, are not visible to the peering, expectant hunter until but a few yards away. The buffalo, big, black, easily trailed, are, just because smaller, even more difficult to follow and see in thick cover, whether of reeds or jungle. Neither animal gets the slightest advantage from its color; indeed the coloration of both is advertising ; but in such cover the coloration is of no consequence, one way or the other. The hunter follows the trail, and if the beast does not hear or wind him, he finally catches a glimpse of it close up — just as the weasel follows the trail of a rabbit or mouse until close enough for the jump. The difference is merely that the hunter follows the trail by sight, and the weasel by scent; doubtless the latter's sharp eyes come in use when the scent warns it that its quarry is close by; and there is no more warrant for supposing that the weasel is misled by the "white stern sky pattern" on such of his victims as happen to possess such a pattern than for supposing that the hunter would be misled if an elephant were similarly ornamented.

Those rhinoceroses that dwell in the bush are hard to see and hunt, whereas in the plains they are, next to the elephant and the giraffe, the most conspicuous animals. In the bush they owe their invisibility solely to the cover; their coloration is of no consequence one way or the other.

The lesser game animals of the thick cover vary so widely in coloration as to render it impossible that the coloration of any one of them can be of real protective or concealing value. In the gloomy, wet mountain forests, choked with vines and undergrowth and down timber, the giant hog and the bongo are the two typical big game animals. The giant hog is almost black; the bongo, an antelope as big as an alderney cow, is brilliantly colored. The coloration of the bongo is, if anything, advertising rather than concealing — it is certainly advertising under any conditions which make the color of its co-dweller in the same haunts, the giant hog, concealing. But as a matter of fact the coloration has not the slightest effect in either revealing or concealing the presence of either animal. Each is so wary, and the extreme thickness of the cover serves each as such a complete shield, that

they are hardly ever seen or shot by the best and most persevering white hunters, and only rarely killed by the wild, naked wood men themselves, unless with the assistance of dogs. The same is true as regards the effect of the coloration of the smaller animals found in the edges of the heavy timber, or in the lighter forests; the bush buck, reed buck, water buck, and bush pig. The bush buck in all its phases is a brilliantly colored antelope, bright chestnut or reddish, varied with white. Its coloration is always advertising. At first I thought the reed buck's coloration was under certain circumstances concealing, but further experience made me come to the conclusion that this was not so, and that I had been misled by the fact that its coloration was not so boldly advertising as the bush buck's. When driven out of a reed bed or thicket or when startled and dashing through one, the advertising effect of the vivid coloration was at once evident. The reed buck was much the easier of the two to see or shoot simply because it was generally found in more open ground. Both owed their invisibility purely to the thick cover in which they dwelt and to their own ability in lying close or skulking stealthily off; their coloration, where it had any effect, was revealing and not concealing. But the effect of the coloration is probably negligible. It was practically impossible to see the grass-dwelling reed buck while the grass was really long; and it became quite conspicuous as soon as the grass was burned. It was the grass and not the coloration which determined whether it should be visible to the eyes of its foes. When it ran it showed its white flag much like a whitetail deer. The water bucks, of two species, were sometimes found in thin forest or patches of dense forest, and in papyrus beds, but more commonly in comparatively open country. When in thick cover they often tried to escape notice by standing motionless or sneaking quietly off, and their coloration was certainly less conspicuous than that of the two smaller antelope; but they themselves were always more conspicuous because of their larger size, their greater clumsiness in skulking, and especially the more open nature of their haunts. One of the two kinds of water buck had a white patch round the rump; which was advertising. The bush pig was a dark colored beast, less conspicuous than the antelope.

We found two antelopes dwelling in the thick swamps, the situtunga and the white-withered lechwe. Both are handsome, striking looking antelopes. The situtunga has a shaggy, dark, nearly monocolored coat. Its coloration is not advertising, in the sense that black or white is advertising, but neither is it concealing, save as any nearly uniform rather dull color is concealing; the extreme difficulty in seeing it — and save its cousin the bongo it is the most difficult of all the big antelopes of East Africa to see — arises practically exclusively from its secretive, stealthy nature,

and the impenetrable cover afforded by the beds of reeds and papyrus in which it dwells. It ventures beyond the edges only at night, and then for but a short distance. The white-withered lechwe dwells in the reed beds and the edges of the papyrus swamps of the middle White Nile. Its coloration is advertising instead of concealing, the old bucks in particular being very conspicuous because of the white of their withers and the upper sides of their necks; and it is a noisy creature, grunting continually. But it is not nearly as easy to see or to shoot as are the antelope of the open plains, for it lives in dense cover and seeks to avoid observation; it will stand motionless in the thick reeds or sneak off through them with neck outstretched and head held low; it does not habitually jump up on ant hills to look about as is the custom of its cousin the kob. The coloration of the doe is almost exactly the same as that of the kob doe, although the habitat and surroundings are different; the kob dwelling on the open plains or among sparsely scattered clumps of grass, bush and trees, where it is very visible, and makes little effort to avoid observation, usually trusting to its vigilance and sharp sight to enable it to see its foes at a distance (although occasionally lying close like a reed buck, in long grass); while the white-withered lechwe spends its whole time in the reed beds, trusting to its surroundings to shield it from the sight of any foe, these surroundings being such that its coloration probably makes no difference either way as far as concealment goes. At any rate the bright red of the does, and the brilliant white back and neck markings of the old bucks, seen against the dark green of the endless reeds, must always be advertising where they have any effect at all.

Here are two water, or swamp, antelope, each trusting for safety mainly to eluding observation, and both living in practically the same surroundings, yet totally different in color; and the one with the less concealing coloration is the one which lives under conditions that would make it more important to have a concealing coloration. The coloration in these cases must be a well nigh or altogether negligible element from the concealing standpoint. A similar lesson was impressed on me by my experience with the various antelope in the Lado, on the west bank of the upper White Nile, during our hunt after the white rhinoceros. For miles around our camp the country was open, covered with tall grass and a sparse, scattering growth of thorn trees, with occasional patches of brush and scrub. During our stay most of the grass was burnt. Where the grass was very long it was almost impossible to see or find any of the antelope, but where it was short or sparse, and especially where it was burnt, the difficulty vanished. Hartebeest, water buck, kob, bush buck, oribi, and dyker were abundant. The bush buck's red coat was marked with white stripes and spots making

the "checkered sun-fleck and leaf-shadowed" pattern which Mr. Thayer considers so potently obliterative. The other species were almost uniformly colored — bright foxy red, straw-tinted, gray, brown. Of course if any one of these coloration patterns was concealing the others must have been advertising. But the difference in coloration sank into insignificance, so far as giving concealment was concerned, compared to the difference in size. The bush buck was harder to see and kill than the water buck, kob or hartebeest, simply because it kept closer to the thickets and patches of long grass and was more given to skulking; but the dyker was harder to see and kill than the bush buck, in the Lado, although its coat was uniform in color without any of the (purely fanciful) advantages Mr. Thayer believes to come from such a "checkered" pattern as the bush buck's; and this merely because the dyker was smaller and was an even greater adept at twisting and skulking through the grass and underbrush. All the antelope were frequently found in exactly the same country; although as a rule the water buck was the only one of the bigger antelope which habitually wandered into the places most affected by the bush buck and dyker — and it was also habitually found in the favorite haunts of the kob and hartebeest. The utterly different colorations of the different animals had, in reality, no effect whatever as regards rendering any one of them more invisible than the others; but of these antelopes those that normally dwell in the open plains were more visible than the others, under like conditions, because they did not try to hide themselves.

So much for the animals which seek to conceal themselves, and which owe their escape from notice to the cover in which they dwell and their ability to hide and skulk. The majority of the big game of the parts of Africa which I traversed dwell in the open, or very sparsely wooded, plains, and do not seek to elude observation at all. One thing that struck me about these animals was the fact that the "countershading" on which Mr. Thayer lays such stress played, so far as I could see, practically no part whatever in concealing them. The animals of the open plain were just as much countershaded as those of the jungle; and, exactly as the animals with least countershading in the jungle were nevertheless as hard to see as the others, so on the open plain those with most countershading were no more concealed than those with practically none. The color itself, the hue of the animal, was of infinitely more consequence than the countershading; although, if the ground was flat and the grass short, the color itself was of no consequence, because the animal, if standing up, could be seen as far as the eye had power. Of two different species, both countershaded — zebras or hartebeests, for instance and oryx or common eland — the first, if colored conspicuously, would be seen a mile or two off, while the other was still

invisible; the difference of course being due to the difference in tint, the countershading being the same, and having practically no effect. I do not mean that the countershading could have been neglected from the artistic or pictorial standpoint. Under certain circumstances, it did make the animal lose its sharpness of outline at a slightly less distance than would otherwise have been the case. But it was of no consequence compared to the general hue of the coloration; and of course, if this general hue was unlike the surroundings, if there was no cover of bushes or of tall grass, and if the ground was flat, the animal could be made out anyhow, by any hunter, brute or human, at a very long distance; within a few hundred yards or less, the outlines were so vivid that the countershading was of no consequence whatever.

The giant eland of the Lado dwelt in a dry sunburnt country, covered with a sparse open growth of scantily leaved trees and bushes; the general tint of the coat, like the general tint of the coat of the roan antelope which dwelt in the same locality, merged well with that of the general landscape; but neither animal sought to skulk or hide, or trusted to concealment, each placing reliance only on its keen senses, and wariness. In East Africa, a buck Grant's gazelle — not the doe or young, which have the conspicuous lateral black stripe — an ordinary eland, a roan, or an oryx, except when either of the latter animals was looking round, so as to show the highly advertising face coloring, might be difficult for the eye to pick up at a distance, even when the wildebeest, topi, hartebeest or zebra in the same landscape were plainly visible; but this was merely because the coats of the four animals first named were of much less conspicuous color than the coats of the second four. The countershading on a wildebeest, which shows dark against the green or brown or yellowish plains, had, not merely practically, but absolutely, no effect whatever in rendering it invisible, for it could be seen as far as a black tree stump, for instance, could be seen. Among leafless bushes and small thickets, and clumps of tall dried grass, an oryx or roan or buck Grant might, if motionless, for a short time escape the notice of untrained eyes, not because of the countershading, but simply because in the flood of bright sunlight, the light, washed-out color of the surrounding objects prevented any vivid contrast and made the eye hesitate in picking out the motionless antelope from its accidented, motionless, shaded and lighted, not very differently colored, surroundings, although these surroundings were solid objects. In other words, the reason for even this partial invisibility was the direct reverse of what Mr. Thayer claims; it was not in the least because the animals were countershaded, for if their general color was in contrast to that of their surroundings they stood out in bold relief; it was simply because the eye was inattentive to individual

objects in the multiplicity of objects, the effects of light and shade being practically the same on the buck and its surroundings, so that among the rocks and bushes and grass clumps and small euphorbias, the body of the buck was not readily picked out. It was chiefly to my own eyes, however, that the trouble was due; the native hunters who were with me could usually pick out the animal at once if within any reasonable distance. Doubtless the same is true of a beast of prey, for evidently none of these antelope, even when they ventured off the open bare plain into the brush, trusted to concealment; they made no effort to hide, and were constantly on the alert to detect foes. But if in very thick and tall grass they did hide, lying still, in confidence that they could not be seen unless stumbled upon; here of course their coloration had nothing to do with their concealment, which was due purely to the dense cover. The only occasions when they were ever in any degree difficult to make out while in the bare open plains was when they laid down, when of course the countershading was at a minimum compared to when they were standing up; the resting antelope looking like some inanimate object. But in the open, even where lying down the antelope were watchful, and trusted in no way to concealment; only the very young fawns sought safety in trying to escape observation, lying motionless with head and neck outstretched.

It was instructive to study the habits of the oribi under changed conditions. The oribi is a small, graceful, swift antelope, well countershaded, with a neutral tinted back, and no advertising marks. Where the grass is long its habits are substantially those of the reed buck, stein-buck and dyker; it lies close, trusting to the protection of the thick cover, and is very difficult to see. But when the grass has been burned, unlike the stein-buck and dyker it takes to the bare open plains, and shows itself as much at home on them as if it were a gazelle. Under these changed conditions it ceases to make any effort to conceal itself, or to trust in any way to concealment for protection, relying purely on its eyesight, wariness, and speed. Although without such advertising markings as those of the Tommy Gazelle, the oribi becomes conspicuous, simply because any animal is conspicuous when on a bare plain, the "counter-gradation" of so-called obliterative shadings entirely failing to conceal any creature, when it alone is in question. Where fire had passed over the plains shooting oribi was like shooting the small gazelle; the little creature was easy to make out a long way off, but great care was needful in order to stalk it within rather long rifle range without being noticed.

Of the game habitually seen on the plains I have already spoken of the elephant, rhinoceros, and even the buffalo, all of which are also found — and in places much more frequently found — in forest or dense jungle.

The giraffe is ordinarily a beast of the open plains, feeding where there is a sparse growth of thorn trees. Mr. Thayer states that the giraffe's countershading and pattern "adequately obliterate" it. As a matter of fact the giraffe is never "adequately obliterated" by countershading or coloration pattern, or by anything else. It is, except the elephant, the most conspicuous of all animals. Its size and shape advertise it unerringly to the dullest sighted lion or native hunter; it can escape observation only if at such a distance that no detail of its coloration would by any chance be visible. The giraffe never under any circumstances seeks to avoid observation. Its one concern is to be so placed that it can itself observe any possible foe. We often found it in the same country with the rhinoceros, a monocolored beast; and in speaking of leopards and giraffe (beasts by the way, which it is as absurd to treat together as so to treat lions and elephants) Mr. Thayer especially dwells on their invisibility as compared with beasts which are "monochrome objects." But the rhinoceros more often eluded hasty observation than did the giraffe, and was less often seen at a very long distance, simple because the height and shape of the giraffe, and the fact that it hardly ever lays down, made it the more conspicuous object of the two. Any animal, of any size, shape or color, may under certain circumstances escape observation, and a man of poor or untrained vision may fail to see animals which could not possibly elude keen eyes, brute or human, if accustomed to the wilderness. But save under wholly exceptional circumstances no brute or human foe of the giraffe could possibly fail to see the huge creature if fairly close by; and at a distance the pattern of the coloration would be lost. The giraffe owes nothing to concealment; its coloration has not the slightest concealing or obliterative effect so far as its foes are concerned.

The zebra has also, very absurdly, been taken as an example of "concealing coloration." Men unused to the consideration of the subject are often surprised when they go outdoors to discern how difficult it is to see any animal — just as a raw city-bred recruit, during his first campaigns, finds it difficult to locate even a civilized foe, and impossible to locate a savage foe, such as an Indian. The more conspicuous the animal the greater is the surprise of the average man when he fails to find it as conspicuous in the landscape as he had supposed; he thinks of a zebra, for instance, as jumping to the eye as it does in a menagerie; and when he finds this not to be the case, he goes to the opposite extreme and supposes that the zebra's coloration is concealing. As a matter of fact it is not concealing, it is highly advertising, when close at hand; but when over three or four hundred yards off the black and white stripes merge together, and the coat becomes monocolored, but catches the sunlight in such shape as still to

render the bearer conspicuous. The narrow stripes of the big Grévey's zebra fade together at a shorter distance than is the case with the broader stripes of the smaller zebra; the broad bands on the rump of the latter can be seen at a long distance. The zebra is purely a beast of the open plains; it never seeks to conceal itself, but trusts always to seeing its foes. When under or among thin leaved, scattered thorn trees it is still usually conspicuous; although now and then a peculiar light and shadow effect may conceal it. It never goes into thick cover save at drinking places, and then only if it is unavoidable; it does not come down stealthily to drink, but openly and warily, always on the watch and continually galloping off on false alarms; it returns to the plains as soon as it has drank; and as such an animal can never escape observation when in motion, and as it is never motionless when at or near the drinking places, it is impossible that its coloration can in any way conceal it at such times. Mr. Thayer's ingenious theories of how all the various stripings on a zebra obliterate it are without the smallest foundation in fact. So far as the coloration of the zebra has any effect at all, as regards beasts of prey, it is an advertising, not a concealing, effect. The wildebeest and topi, which are found in company with it, are more conspicuous; the hartebeests sometimes more and sometimes less, according to the sunlight; the eland and oryx and gazelle less. A moment's thought ought to show Mr. Thayer and his adherents that animals so differently colored as these, all leading their lives under similar conditions, cannot possibly all be concealingly colored. As a matter of fact none of them owe their safety to concealing coloration, and the majority of them are advertisingly colored. In East Africa the lion preys chiefly on zebra and hartebeest, which live under precisely the same conditions, have the same habits and associate in the same herds; yet two more differently colored animals cannot be imagined, and neither is concealed in the slightest degree by its coloration. Among the hunter-naturalists to whom we owe most of our knowledge of the enthrallingly interesting life-histories of African big game, Captain Stigand comes second only to Mr. Selous. When I wrote of protective coloration in 'African Game Trails,' I had had opportunity only to glance at Stigand's admirable book on the game of British East Africa. In this he discusses the subject in masterly fashion, and with a knowledge that could only come to a trained big game hunter and field naturalist gifted with exceptionally keen powers of observation and analysis. I quote a few lines: "Very few animals seem to rely on protective coloration as a means of escaping observation, however they may be colored. They appear to rely on fleetness of foot, quickness of eye and ear, or on scenting powers.... (the animals that do trust to hiding) seem to rely more on cover and concealment or partial concealment

than on any great similarity to natural objects. . . . even if (the larger game of the plains) were perfect examples of protective harmony, which I do not admit, it would avail them little when their lives are spent in walking about in the open. For a moving object even if it assimilates in color to its surroundings always catches the eye of a practiced observer. The two most absurd, but often quoted, examples of wonderful instances of protective coloration are the zebra and the giraffe. It is true that the zebra in very long grass is sometimes difficult to pick out, but so is any animal almost entirely concealed from view — even an elephant if the grass is long enough. In their usual East African habitat (the plains) zebras are strikingly conspicuous, turning from black to white as they move and their sides are alternately in shadow or exposed sunlight. . . . A giraffe near, or even in the far distance, when not screened from view, is a most conspicuous object to the practiced eye."[1]

The other common plains game, in order of conspicuousness I have already mentioned — wildebeest, topi, hartebeest, eland, oryx, the gazelles. The latter on account of their advertising lateral stripes, would be more conspicuous than the eland were it not for their small size. In one of the appendices in my 'African Game Trails' I have discussed their conspicuousness more at length. The various species and subspecies of eland which I encountered in Africa are striped, the stripes being very narrow. Mr. Thayer says these stripes are "secantly obliterative"; — that "they bring down as it were narrow slips of the sky into the beast's smooth contour" or "carry the aspect of stray, gleaming grasses or reed stems upwards across the eland's earth-colored obliterately-shaded body." They do nothing of the sort, and this utterly wild and foolish guess, without one particle of justification in fact, is typical of the recklessness with which

---

[1] In a recent statement by Mr. Thayer, he says that those who do not agree with him are "childish," in misapprehending his thesis, which is that the coloration of all animals is "obliterative" at "the crucial moments when they are on the verge of catching or being caught." He reiterates his position as follows:— "The zebra and the African antelopes, the peacock and the bobolink, are all. . . . marvels of concealing coloration in situations where concealing coloration is of use to them. . . . concealing coloration *is universal* among species that catch or are caught." Any schoolboy fit to be trusted out of doors alone can set Mr. Thayer right as to the bobolink; Mr. Beebe, in his forthcoming book about his Asiatic trip, will deal with the peacock and pheasants. As for the zebra and the African antelope, Messrs. Stigand and Selous have stated the exact facts; and their statements are based on years of patient, keen intelligent study and observation in the field and cannot be successfully controverted. Mr. Thayer's assertion, as regards the zebra and most African antelope, has not even the smallest justification in truth. In all that I have said above about the coloration and habits of the zebra, and the big antelopes which have similar ways of life, I have kept steadily in mind (as Messrs. Selous and Stigand have done) the view point of the beasts that prey on them, and the actual conditions at the crucial moments when the zebra and the antelope are either caught or escape; and at these moments, so far from being "marvels of concealing coloration," the animals are not concealingly colored, and receive not the smallest help from their coloration.

Mr. Thayer calls on his imagination to furnish backing for his theories. The eland's body is countershaded; but it is not "obliterated," at all. It lives in the bare open plains or among thin brush and thorn trees. It is not as conspicuous as the wildebeest or topi; but it can always be seen a mile away, unless screened. The stripes cannot be seen at all until the eland is so close that no brute or human hunter could possibly fail to see the animal. The eland while unhurt never seeks concealment; its one desire is to be on the lookout for its foes. Its stripes never, under any circumstances, help to conceal it in even the smallest degree; any more than the lack of such stripes on the bodies of the oryx and roan antelope (which in many regions are associated with it) in any way reveals or advertises them. Any knowledge of the habits of these animals and of the fact that they dwell amid exactly the same surroundings, or any serious effort to think out the facts, instead of manufacturing facts to bolster an absurd theory, would have prevented Mr. Thayer from supposing that either the presence or the absence of these stripes had the slightest concealing effect. The southern form of eland which lived under exactly the same conditions was unstriped. On the same page on which he records this theory, Mr. Thayer advances the still wilder one, that the white markings on the harnessed bush buck resemble "flecks of water shine"; and to back up this theory he supposes that these bush buck spend an unusually large proportion of their time in and about wet swamps and river borders. They spend much less time in such places than the situtunga or lechwe, which lack the spots; less time than the gray or reddish water-buck; no more than many other antelopes; and of the many I came across, not one was ever in such a position as to render it possible that even the most foolish onlooker could mistake its spots for "flecks of water shine." I dislike to speak harshly of a well meaning enthusiast like Mr. Thayer, but from cover to cover his book is filled with such phantasmagoria as this; only the smallest fraction of what he writes deserves consideration; and yet he has received much consideration even from scientific men who cannot plead any of the excuses which can be advanced to shield Mr. Thayer from criticism; and therefore, in the simple interest of truth, I am reluctantly compelled to say what ought to be said of his book.

Most of the smaller patterns on big animals never can have any effect either in concealing or advertising them; probably patterns have to be as big as the face markings on the roan of oryx before they have such an effect, which is then advertising. The face markings on the roan and the oryx were beyond question advertising. On the Guasi Gishu plateau we saw one topi with a blaze of white on its face; this made it very conspicuous among its fellows (like the face of its South African cousin the blesbok). The face markings on an eland are too small to be advertising. Ordinarily

the details of a small pattern merely merge into one broad mass of color; the brindled hide of a wildebeest looks in most lights as if it were one color. The coloration of the sable antelope is strikingly advertising; that of the roan is very much less so; yet it is an illustration of how little coloration counts in concealment that the two species have substantially the same habits, and the roan no more trusts to, or benefits by, its coloration than does the sable. When in the open neither tries in any way to escape observation; and in cover both trust purely to the cover for concealment. The white-eared kob of the middle White Nile is advertisingly colored, especially in the case of the old bucks, but the common kob and Vaughn's kob are also, although less markedly, advertisingly colored. The impalla is another antelope with an advertising coloration; the buck, when under the influence of erotic emotion, spreads the hair of his rump in chrysanthemum fashion, like our pronghorn.

The warthog, a beast of the plains, is dull colored; but it is always easy to see unless it is screened by grass or brush.

Five small antelopes can be treated together — the dikdik, dyker, steinbuck, Chanler's buck and klipspringer. The first three dwell in grass and brush, the last two on rugged and stony hills. I always found the klipspringer and Chanler's buck difficult to see among the rocks; their coats harmonized with the varied earth and rock surroundings; and they were the only two antelope I saw in Africa of which it could perhaps be said that they were helped by their countershading. All the other antelope and the zebra, pig, etc., either live boldly in the open, paying no heed to concealment, and not being concealed, or else live in cover and trust for concealment, not to their coloration, but to the screen of the cover, which protects them no matter how glaringly they are colored; and none of these animals seem to be affected one way or the other by their coloration, and would not be damaged if their "countershading" were reversed, and they were colored lightest on top. This last, indeed, is precisely what happens in the case of the white-withered leckwe, with its white withers and upper neck, while the black lateral stripes on the gazelles practically invert the countershading. On the topi the countershading is actually and completely inverted, the back being lighter than the sides and especially than the shoulders and haunches: yet this inverted countershading makes not the slightest difference in their habits or visibility as compared with the ordinary countershaded hartebeest and wildebeest. The klipspringer and Chanler's buck were certainly hard to place, apparently because of their coloring, when they were standing in range of vision among the rocks — although I am by no means sure that this was not due to lack of keen eyes on my part, for my native hunting companions almost always saw them, and the klipspringer was a

noisy, alert little animal, not seeking to hide, while the white on the belly and around the tail of the Chanler's buck now and then served as a striking advertisement. It may therefore be that neither is really helped by its color in concealing itself from any of its natural foes; but I mention both, because they were the only antelopes I saw for which it is even possible to make out a claim for the possession of concealing coloration. The other three small buck, the dyker, dikdik and steinbuck, afford yet one more illustration of the fact that with most game animals coloration makes no difference one way or the other. They trust to the brush and grass for concealment. The two first, in the region in which I hunted, were dull colored, while the steinbuck's coat was a foxy red, unlike its surroundings at every season of the year, and always conspicuous; yet all three had the same habit of lying down to hide, and of sneaking stealthily or rushing madly through the grass and brush, and it was evident that all three were equally protected without regard to their coloration, by their habits and by the screen afforded by the cover in which they dwelt.

Among the several carnivores the black-backed jackal was conspicuous in coloration compared to his silver-backed brother; but the coloration evidently had no effect one way or the other on either, so far as revealing it to prey or to foes was concerned. The white-backed, black-bodied ratel and white-tailed mongoose were advertisingly colored; most of the small cats, civets, and ichneumons, whether monocolored or variegated, were hard to see, chiefly because they were nocturnal and lived in the brush and grass — although as regards one or two of them I believe a case could be made for concealing coloration. The spotted, and still more the striped, hyænas were nocturnal. The hunting dog and cheetah were rather easy to see; at a distance the latter looked like a lioness. The lion, and even more the leopard, however, were past masters in the art of concealment. The coat of one is a uniform tawny, that of the other is beautifully spotted; they are as unlike as possible, and when the animal is crouched flat, as always when hiding, the effect of the countershading is almost nil on either. Their habitats overlap, and from actual experience I can testify to the fact that in the same seemingly scant patches of brush and grass both animals — and also the serval, which is found in the same places — are able to conceal themselves almost equally well. The way they will both hide in apparently inadequate cover is marvelous. The lion's mane, especially if black, is advertising; yet he is practically as difficult to make out as a lioness when in cover. The chief and overwhelming element in the concealment of either big cat is its extraordinary ability to crouch flat and motionless, and to crawl stealthily and noiselessly, very low and near the ground, taking advantage of every scrap of cover. If we keep in mind the case of the cougar we shall

realize the exact facts. Mr. Thayer gives a picture of the jaguar, the American leopard, with an artificial leaf landscape background (incidentally not merely an artificial but an untruthful landscape) designed to show that the spots, because of their likeness to a "sunfleck and leaf shadow pattern" obliterate the animal; and states that he has "demonstrated" the fact that such a highly spotted body is visible against a plain background and also "the noticeableness of a monochrome object against a patterned background." Now, in the first place, Mr. Thayer ignores the fact that cougars are just as plentiful as (indeed probably much more plentiful than) jaguars in just such leaf landscapes as he depicts, and that therefore he has "demonstrated" the noticeableness, or advertising, or revealing quality, of the cougar in what are on the whole its most ordinary surroundings — which is a false demonstration; and in the second place he ignores the fact that leopards are continually found in grass, where there are no leaf shadow patterns, and yet that they are just as hard to place under such conditions as are lions and servals — disregarding the matter of size. One of the leopards my son shot was in the grass on an ant hill, but it was as difficult to see as we found lionesses and servals to be under similar conditions. I believe that the lion's coloration, like the cougar's, is on the whole more concealing or obliterative or protective than any other; but the leopard's pattern, although perhaps less concealing, is not an advertising pattern when compared with solid black or white for instance; and moreover the fact that black-maned lions, and in places entirely black leopards and servals, keep in as good condition, and are as successful in eluding observation and catching prey as their normally colored kinsfolk, and the further fact that monocolored cougars are under the same conditions as prosperous as jaguars, prove that the question of coloration is of very slight, if any, importance, and at any rate of wholly minor importance, in concealing these great cats. Their sinuous, gliding stealth of movement, the flexibility with which their bodies mould themselves along or around objects, their power to lie motionless, their wariness — in short their genius for seizing every opportunity to hide, and the extraordinary skill with which they use cover, not to mention their generally nocturnal habits, are what render them able to conceal themselves in such marvelous fashion.

These statements of fact, are based on my personal observations in the field, and on those of my son Kermit. They are the result of conscientious and painstaking, although necessarily far from exhaustive, first hand studies, in their haunts, of the following big game, and carnivores, in North America and Eastern and Middle Africa:

North America.

Cougar.
Lynx.
Coyote.
Red fox.
Gray fox.
Grizzly bear.
Black bear.
Bison.
Bighorn.
White goat.
Prongbuck.
Moose.
Caribou.
Wapiti.
Whitetail deer.
Rocky Mountain blacktail deer.
Coast blacktail deer.
Peccary.

Africa.

Lion.
Leopard.
Cheetah.
Serval.
Spotted hyæna.
Striped hyæna.
Hunting hound.
Aard wolf.
Black-backed jackal.
Silver-backed jackal.
Elephant.
White rhinoceros.
Black rhinoceros.
Grévey's zebra.
Common zebra.
Hippopotamus.
Warthog.
Bush pig.
Forest hog.
Common giraffe.
Reticulated giraffe.
East African buffalo.
Abyssinian buffalo.
Giant eland.
Common eland.
Bongo.
Bush buck.
Koodoo.
Situtunga.
Sable antelope.
Roan antelope (two subspecies).
Oryx.
Grant's gazelle (three subspecies).
Thomson's gazelle.
Gerunuk.
Impalla.
Chanler's rock buck.
Reed buck (two subspecies).
Common kob.
Red white-eared kob.
White-eared kob.
Common water buck.
Sing-sing water buck (two subspecies).
White-withered lechwe.
Gray dyker (two subspecies).
Rufous dyker.
Steinbok.
Oribi (two species or subspecies).
Dikdik.
Klipspringer.
Wildebeest.
Topi.
Jackson's hartebeest.
Uganda hartebeest.
Kongoni hartebeest.
Neuman's hartebeest.
Nile hartebeest.

This makes a total of between seventy and eighty animals which because of their size must on the whole be looked at by hunters from about the standpoint that the big cats and the wolves look at their prey; from the standpoint that bobcats, foxes, minks and weasels look at rabbits, woodchucks, gophers and mice. The animals observed were sufficiently numerous in species and individuals — of some I must, all told, have seen many thousands, under every conceivable circumstance and surrounding — to give some warrant in generalizing about them. I have touched above on the coloration characters of some of them; the characters of those I have omitted are similar and teach identically the same lessons.

Among these animals a fair proportion are not merely not concealingly colored, but have a strikingly advertising or revealing coloration. The prongbuck, white goat, black bear, the wolf when either in the white or the black coat, the giraffes, zebras, sable antelope, wildebeest, topi, white-eared kob, and white-withered lechwe are so colored that unless screened by cover it is almost impossible for them to avoid attracting attention under normal conditions. Many of the other animals, although not so glaringly conspicuous, nevertheless possess a coloration sufficiently conspicuous to ensure their being seen by any brute or human foe that trusts to eyesight at all; for instance, the impalla, bongo, bush buck, whitetail deer, and all the plains antelopes of Africa, not one of which, from the eland, roan and oryx to the gazelles, ever tries to escape observation or lives under conditions which would enable it to escape observation. There remains a minority of the grass-eating animals, which live in forests or swamps, whose coloration if not exactly concealing is at least not conspicuous. These, however, do not seem to be any better able to shift for themselves than such of their neighbors as happen to be advertisingly colored; the little antelopes that are foxy red do just as well as their neutral tinted neighbors; and the same is true of their big kinsfolk. The forest and swamp dwellers of dull and uniform coloration and those of bright and varied coloration get on equally well, and are equally hard to see or kill; it is evidently the cover and the beast's shy, wary watchfulness, and not the coloration, that count.

The coyote may possibly be helped by countershading. In only two other cases, and in both of those very doubtfully, does it seem as if this countershading, on which Mr. Thayer lays such stress, can play even the smallest part in protecting or concealing these creatures. A glance at the facts in connection with their lives shows, in the first place, that the countershading is of absolutely no consequence if the general hue is not the same as that of the background. The wildebeest and hartebeest for instance are countershaded; but they are not "obliterated" at all, simply because the plains on which they dwell are always green or dull brown or faded

yellowish brown, and against such coloring their own vivid colorations stand out with advertising distinctness. Moreover, it cannot too often be repeated that if the animal is black above or white below, such coloration, whether called "countershading" or anything else, is always advertising, in so far as either color can be seen. Of course, if the white belly is invisible it becomes, not a *concealing* color, but a *concealed* color — which is wholly different. A favorite expedient of Mr. Thayer's is to request his hearers to consider how conspicuous these animals would be if upside down, especially because of their white bellies. He instances the tiger as a case in point. Of course, if the tiger's coloration were reversed it would make the animal conspicuous, but this would only be because the white, which had hitherto been hidden, had been made visible. As a tiger actually stalks his prey, the white on his underparts does not "obliterate" him; he crouches so that it is itself obliterated; if it were seen at all, it would advertise him, no matter what part of his body it was on. As a matter of fact, judging from what is true with the lion, cougar, leopard and black leopard, it would probably make no difference whatever to a tiger, so far as his prey is concerned, whether the non-white portion of his coloration were or were not countershaded. The sambur, the big jungle deer of India on which the tiger frequently preys, actually is inversely countershaded, being darkest below, and of a general monochrome tint; but it is hard to see, nevertheless.[1] On this point the cases of the topi and the white-withered lechwe are illuminating. The topi is inversely countershaded, in exactly the way that Mr. Thayer says would be most advertising; but the topi is not as conspicuous as the countershaded wildebeest, bull sable and buck white-eared kob, simply because their colors are even more striking than his, and because the intensity of the color is much more important than the pattern of coloration or than the shading. The white-withered lechwe actually does have the white on its back as Mr. Thayer supposes of his inverted tiger; but the effect on the animal's "concealment" is almost nil, simply because it trusts, not at all to its coloration, but purely to the screen afforded by the cover in which it dwells; just as is true of the bongo, situtunga, bush buck, dyker, etc., in not one of which does the coloration play any concealing part whatever.

I have seen a cow elk with a calf, whitetail deer, and blacktail deer in summer, seek to escape notice by lying motionless on the ground with outstretched necks; but in each case it was the cover, and the absence of motion, that gave concealment, and not the coloration; for the red coat of

---

[1] In Mr. Hornaday's 'Two Years in the Jungle' he mentions that he found the sambur very hard to see, because of its coloration; evidently the lack of countershading was of no effect. The only tiger he came across he speaks of as strikingly and conspicuously colored.

the whitetail was really conspicuous, and so was the pale rump of the blacktail. Similarly, in fairly thick brush, I have come close on water-buck cows and impalla does lying down with their young; but as the background was the same in both cases, it was of course impossible that the gray of one and the bright red of the other, could both be concealing; and as they were lying down the countershading had no effect. Evidently, the question of color was negligible compared to the thickness of cover and absence of motion. Once I mistook a water buck cow lying down for a log, just as once or twice I have been unable to tell whether what I saw was a black bear or a stump; but this merely means that any motionless object, of any color, may at times be mistaken for an inanimate object, if the surroundings are right. In sum, the study of these seventy-odd animals shows that, as far as they are concerned, coloration plays an insignificant, and counter-gradation a practically negligible, part in protecting or concealing them from their foes. The cats are adept at concealment no matter what their color. The herbivores, if they live on open plains are never concealed, and never seek concealment or profit by it; if they live in cover they are concealed, but they owe this concealment almost purely to the screen afforded by the cover, and thrive equally well, apparently, whether their coloration is or is not advertising. That cover, and not coloration, is the all important element in concealing crouching animals, is shown by the fact that wapiti, deer, water buck and impalla never crouch or squat on bare open plains, although they often crouch or squat in long grass or thickets. The fact that countershading is of no consequence is shown by the case of the inversely countershaded topi, as compared with the countershaded wildebeest and hartebeest, in Africa; and of the inversely countershaded, or non-countershaded, moose and wapiti, as compared with the countershaded small deer in America. The topi's habits and visibility are the same as those of his kinsfolk the wildebeest and hartebeest; the moose gains the same advantage from cover that the whitetail does; and the wapiti crouches flat to escape observation just like the whitetail. The presence or absence of countershading makes absolutely no difference in the habits or the conspicuousness of these animals. It has in all probability just as little effect as regards the immense majority of small mammals, like mice and shrews.

Mr. Thayer's theory leads him into rather startling vagaries when he applies it to rabbits. Rabbits when squatting are undoubtedly concealed by their general neutral coloration, and it is just possible that a case can be made for the effects of countershading as far as they are concerned (although in a crouching rabbit seen from behind the effect of the countershading vanishes); but Mr. Thayer is not content with this, and en-

deavors to show that certain conspicuously advertising features of their coloration are really concealing. Indeed Mr. Thayer seems driven by an imp of the perverse, for in addition to insisting that the advertising features of the rabbit's coloration are obliterative, he also insists that the features of its coloration which really are obliterative, are advertising. He states that the white tail of a running rabbit obliterates it, in the sight of a weasel or fox, that its "white rump vanishes against the sky from the sight of the creeping fox or other quadruped pursuer. The fox's eyes are at that moment lower than the hare's tail, and he sees it against the sky (or, in the woods, the sky's light through the leaves)." Then he states that a crouching hare is "boldly conspicuous" when seen from the position of any "quadruped pursuer" that would have to look upwards at the hare's tail. One trouble in arguing against this theory is that encountered so often in controverting Mr. Thayer: the theory is so preposterous that to controvert it is a little like arguing with a man who says that two and two make five. If a sitting rabbit is "boldly conspicuous" to an animal on a level with it, then all of Mr. Thayer's theories go by the board at once, and all animals are always "boldly conspicuous," to their foes; for if a sitting rabbit in the woods is not inconspicuous, whether to a weasel or any other creeping foe, then no mammal alive is inconspicuous in the eyes of any ordinary ground foe. But it is an equally wild absurdity to suppose that the white rump of a fleeing rabbit even for a moment obliterates it from any foe. It is not seen against the sky line, by a weasel or fox or wildcat, once, for the hundreds of times when it is seen against a background of forests or bushes or grass, and then it is always conspicuous. Whether the rabbit is above or below the level line of vision of the enemy makes not the slightest difference. A rabbit running away on the hillside above one is exactly as conspicuous as a rabbit running away down hill. A man a hundred yards off has his line of vision practically on a level with that of a fox close up; and yet if the man's eyes are good he can see the bobbing white rump at that distance, even if he can see little else. In creeping up to big game I have more than once startled rabbits, and though my eyes were then on a level with those of a fox, I could see the white rump of the rabbit just as well as if I had been erect. Indeed, this proposition is so self-evident that it is well nigh impossible to understand how any man who has walked in the woods can for a moment accept such a fantastic theory as Mr. Thayer's. The white, the advertising color of the rabbit, is invisible while it crouches motionless seeking to evade observation, but as soon as it runs the white becomes so conspicuous that no animal — whether an enemy or a young rabbit — whatever the position of its eyes, if it can see at all, can avoid seeing the advertising white mark and the rabbit itself.

Whether the white rump marking is more than unconsciously advertising, I cannot say; but Mr. Nelson in his very interesting study of North American hares has shown that certain jack-rabbits do consciously advertise themselves when they run, in extraordinary fashion, drawing the white belly skin round so as to make first one side and then the other side show white.

Mr. Thayer's pictures of rabbits illustrate both his inability to understand the circumstances which make white an advertising color, and his, of course unconscious, arrangement of facts so as to twist them into support of his theory. He states that "almost all mammals" are "equipped with a full obliterative shading," white being "by far the commonest color" for the middle of their undersides, and the dark of the upper sides often culminating in a black medium line. This mere statement of his case shows that he has wholly failed to grasp the fact that under normal conditions in nature countershading is never obliterative unless the animal's general tint agrees with the general color of its surroundings, and unless the countershading is not abrupt and marks merely a change of intensity in what remains practically the same color. His statement of the fact as to the frequent occurrence of a black dorsal line and the general occurrence of a white belly among mammals is correct, and this is merely another way of stating that generally they are *not* equipped with a full obliterative countershading; for such a black dorsal line is generally advertising or revealing, and a white belly or underside is under normal conditions always, and to a higher degree, advertising *whenever it can be seen at all.* A rabbit sitting in normal position has no dorsal black line, and all, or practically all, the white is concealed; there remains merely a neutral tinted object, very difficult to observe in thick cover or in any landscape where there are roughnesses and inequalities, lights and shadows, and grays, browns and drabs. I am inclined to believe that such a sitting rabbit if seen from the side is slightly helped towards concealment by its countershading; nevertheless the countershading is certainly a minor, and is perhaps a negligible, factor in the concealment; for it plays no part if the animal is sitting rear end on; and on a bare open plain, where there is no cover, and no stones or clods to distract the eye, a sitting rabbit will be seen at once, a jack-rabbit, for instance, looming up on such a plain while still very far off. This shows that the countershading by itself counts for little or nothing, and that the only part it plays — certainly a very small part, if any — is slightly to aid in concealment by a slight blurring of the sharpness of outline when the rabbit is shielded by grass or crouches among similarly colored and shaded inanimate objects.

Mr. Thayer gives two photographs designed to show that the rabbit

owes its concealment to countershading. The first gives a rabbit sitting in a natural position; the second the same animal on its back, upside down. (In the second photo, incidentally, the background is made much darker, so as to bring out the white in sharp relief; while in the first photo the ground is made so white around the white tail as to harmonize with it.)[1] These photos are interesting because they show that even with the facts before his eyes Mr. Thayer does not realize the essential truth that when in normal sitting attitude, *the white does not conceal the rabbit, but the rabbit conceals the white.* The white is not concealing; it is itself concealed. In the second picture the white on the rabbit is rendered conspicuous primarily because the white is visible. The white tail which in the picture is underneath one end of the rabbit is just as conspicuous as the white belly, which is uppermost. The position of the white, whether above or below, is of no consequence; it is the fact that it is *seen* that makes it conspicuous; of course as long as it is invisible it cannot be conspicuous. When the rabbit is still it sits on, and completely hides, its own advertising color; and this is one chief reason why it is then so inconspicuous, compared to its great conspicuousness in motion. It trusts for concealment chiefly to the actual screen of the cover, but partly also to its coloration, to the general neutral effect of its coloring, which harmonizes with the tints common in woodland landscapes and in open landscapes where there are bushes, clods of earth and patches of dry or half dry grass.

Mr. Thayer frequently attempts to substitute for an entirely well-known and accepted truth some brand new, and glaring, error. His treatment of the skunks affords one of the best instances of this trait. These pied black and white creatures are among the most conspicuous objects, animate or inanimate, in nature. Therefore Mr. Thayer, with ingenious wrong-headedness, endeavors to show that they are really concealingly colored. At first he seems inclined to think that skunks may be conspicuous when seen from above; but by the end of the book he has worked himself up to the belief that for one skunk thus seen there are "thousands of other skunks absolutely unrecognizable through the disruptive effect of their bleached leaf-and-shadow colors," and that, as regards the mice and insects on which the skunk preys, it is obliteratively colored, the "paramount function" of its coloration pattern being "the picture of sky," because the "white on its

[1] Contrast these pictures, carefully chosen to bolster an untenable theory, with those in Mr. Warren's 'Mammals of Colorado,' taken merely to show the facts. On pp. 48 to 51 he shows a cotton-tail in the open and a cotton-tail under a sage brush. Although sitting sideways to the camera, the rabbit photographed in the open shows practically no countershading; its coloration would help it only if of the same tint as the background. The rabbit under the sage brush is far harder to see; merely because cover counts for infinitely more than color in concealment, even when, as in the case of the rabbit, the coloration also has a concealing quality under certain conditions.

upper side . . . .serves to imitate, to picture, the shining sky from which the underside is shaded." He illustrates this by a series of as thoroughly misleading pictures as even his book contains. He explicitly states that skunks are nocturnal; and it does seem incredible that he should believe that white is inconspicuous at night. This is one of those elementary facts as to which it is not possible to argue; it is only possible to state them. White is far and away the most conspicuous color at night. On the western cattle ranches we often used to choose a white night horse just because we could most easily see him. If we have to follow a mounted guide at night we always prefer one with a white horse; and in marking the color it makes little difference whether he is above us, on a hill side, or below us; the white horse is always more visible than a horse of any other color would be. Let any man go out into his pasture after night fall; he will find that the white cow is the easiest seen. Let him follow a friend through the woods at night; he can follow a white shirt better than a black coat. If we wish to shoot at night we tie white along or around the rifle barrel, whether we expect an animal to appear over the sky line or not. Moreover the skunk hunts chiefly in forest, in brush, or in high grass, only occasionally in short grass; so that a mouse or cricket, if it sees the skunk at all, must see him hundreds of times against a background of leaves or grass for once it sees him against the sky. All this also applies to Mr. Thayer's theory as to the effect the white head markings of a skunk have in puzzling its prey; together with the additional fact that among the skunks, ratels, zorillas and kindred beasts of bold black and white coloration, most of them, including many or most of the skunks, wholly lack these head stripes. Very little of what Mr. Thayer says about "sky pictures" has any more substantial foundation than in the case of the skunks — in other words it has no foundation whatever in fact. So with what he says of "ruptive" and "secant" colors. They are generally highly advertising, this being the case with skunks, colobus monkeys, black and white chats, red-headed woodpeckers, guillemots, murres, auks, oyster-catchers, eider ducks, black and white storks, etc.

Often and often, like most hunters and field naturalists, I have run across skunks at night; they were usually the only ground animals I could see at night at all; and I saw them equally well whether below me or on a hillside above the level of my eyes. Now and then, on a dark night or even in moonlight, I came across a skunk under conditions which made it difficult to see; but under these same conditions any ordinarily colored animal would have been not merely difficult but impossible to see. The simple fact is that, disregarding exceptional and abnormal conditions, the skunk's coloration is, in all places and at all times, in the highest degree advertising, and this whether it is seen from above, from below, or from

one side. It is no more concealing than a sunflower's coloration is concealing; and to speak of a skunk as inconspicuous is precisely as if one used the same term in describing an isolated clump of sunflowers on a Nebraska prairie, where they loom up like a steeple.

Squirrels vary widely in color. The gray seems to me to be concealingly colored as far as his upper parts are concerned; but the white belly, wherever seen, is advertising; and the coloration of the black variety is certainly advertising. The big fox squirrel of the south, in almost all its varieties, but especially when black, or dusky, or orange-bellied, possesses a highly advertising coloration. The red squirrel's coloration seems to me on the whole advertising; and the chipmunk's unquestionably is, in most surroundings. If the chipmunk were as big as a deer we should realize that its stripes and bright red body color, with its white belly, make it very conspicuous. The flying squirrel is nocturnal, or occasionally crepuscular; its upper body colors may possibly be called concealing, although probably almost any color would be equally concealing at the time this little creature is abroad; but the white of the underparts is always advertising when it can be seen at all.

Taking into account the way in which the black and orange-bellied squirrels thrive, and the fact that so many of the squirrels carry pure white beneath or on the sides, it seems that the arboreal squirrels are not affected one way or the other by their coloration, which is sometimes advertising and sometimes concealing. Evidently their watchfulness, agility, and ability to use the cover of the trunk, branches and leaves, count for so much in preserving their lives that from this standpoint their coloration becomes insignificant, and probably negligible.

The spermophiles, or gophers, striped, spotted or plain colored, offer a slightly more puzzling problem. They live in burrows, and are watchful when above ground; one of the favorite poses of certain species is to stand erect, looking like picket pins. But most of the species have a coloration which at a short distance merges into a neutral tint, not readily distinguishable in the dried grass and among the earth clods of its usual haunts, and fairly to be called concealing. The exact pattern is of no consequence; in all these beasts and birds the minute patterns, or minute portions of patterns, cannot be distinguished at a sufficient distance to make their tiny differences of any effect in concealing or revealing their wearers; it is merely the general effect which counts; and the general effect may be obtained indifferently by a uniform dull gray or drab or brown, or by faded stripes or dull spots. The rock spermophile is hard to make out in its native haunts, because its coloration harmonizes with the surroundings; but when not in motion it squats; and when squatting it shows no countershading, as may be seen by inspecting the mounted specimen in the American Museum.

A considerable number of these gophers, and ground squirrels, then, may be deemed to possess concealing coloration, or at least to possess various coloration patterns none of which are advertising. But some of them, and their near kinsmen, are advertisingly colored; for instance, the curious little antelope squirrel, whose tail is used in a way only compatible with the theory that it is an advertising mark, and indeed probably consciously or semi-consciously used for advertising or revealing purposes. Many of the woodchucks and prairie dogs are certainly not concealingly colored. The ordinary prairie dog is advertisingly colored when in grass, whether green or dry; its color harmonizes well with much of the soil in which its towns are placed; but as it never seeks to hide, is always jerking its tail or otherwise in motion, and trusts exclusively to its watchfulness and its burrow for protection, I think that every competent observer who has ever watched its habits in a state of nature will agree that concealing coloration neither plays nor can play any part whatever in its life. It is a diurnal animal, whose habits are such that although it is diurnal it never seeks concealment above ground nor trusts to either cover or coloration for concealment; whereas multitudes of animals which are nocturnal trust purely to the cover of the night and not to their coloration, for concealment and protection. Woodchucks, unlike prairie dogs lead their lives under such conditions that certain species at times may be benefited by concealing coloration. Ordinarily, however, concealing coloration plays a very small part in their protection, and countershading practically no part at all. The coloration is only advertising when the dark-colored animal is amid green or light colored surroundings. In the Rocky Mountains the woodchucks are wary, ever ready to whistle their shrill alarm note, and by day rarely venture far from their holes; they are difficult to make out, merely as the conies are, because the eye picks them out with difficulty among the broken rocks, pebble heaps, bushes and plant tufts; as far as I can tell, their countershading plays absolutely no part in concealing them, the effects of light and shade on their motionless crouching or sitting bodies, colored brown or gray, making them hard to distinguish from the browns and grays of the variously shaded and lighted surrounding inanimate objects. The eastern woodchuck is largely nocturnal; according to my observations it rarely ventures far from its burrows into open country during daylight, and then trusts to its watchfulness to warn it of the approach of a foe in time to permit of flight to its home. In a clover field a woodchuck, unless completely screened from view, is very conspicuous, because of the color contrast of its body against the green. In the woods it is generally more difficult to see, and here its coloration is at least not advertising, as is a skunk's for instance; but I do not think that even in the woods the exact shading of a

woodchuck's coat is of any consequence in protecting it; the concealment comes merely from the fact that the coloration is not sufficiently vivid or strongly marked, either in color or pattern, to advertise it to a degree that would offset the advantage conferred by the actual screen of twigs and leaves, or the obscurity of the light and the bewildering effect on the eyes of countless different shadings and forms of the surroundings. In other words it is not the woodchuck itself which is so colored as to be invisible (it is readily seen on any flat surface, clear of inanimate objects); it is the many colored and many shaded, obscurely lighted, highly accidented surroundings, which tend to make it difficult for the eye to pick out from among them any motionless creature unless the latter is colored in some bold and striking fashion. In the woodchuck's case, and in an immense multitude of similar cases, any one of hundreds of patterns of coloration, varied or uniform, would be equally concealing; all that natural selection can have done in this line, if anything, is to have prevented the development of such bold and striking coloration as that of the skunk or wolverene or logcock or red-headed woodpecker, leaving the exact pattern or tint to be determined, within very wide limits, by some wholly different cause or causes. The prime qualities necessary to the woodchuck's preservation are certain life habits, such as remaining in the day time near enough to its burrow to enter it very speedily, venturing on long rambles only at night; watchfulness, ability to crouch motionless if it suspects danger when far from home, and the use of grass or bush cover. Some species of woodchuck are slightly countershaded; others, as can be seen by inspecting the mounted specimens in the American Museum, are not countershaded at all; and neither the presence nor the absence of the countershading has the least effect on the beasts' conspicuousness or habits.[1]

Recapitulation.

To sum up and recapitulate,[2] Mr. Thayer's contribution to the old doctrine of "concealing coloration" (which is substantially although not quite completely, the equivalent of the older phrase "protective coloration") consists in making it universal and all sufficient to explain any color of any kind on practically every animal; and in basing it upon countershading which he asserts to be the overwhelmingly dominant factor in producing it; and he regards this universal concealing coloration as the product of

[1] The western woodchuck of Colorado is slightly countershaded; yet the photograph of it from life in Warren's book shows that in an ordinary light the effect may be as if the countershading were inverted.

[2] Let me here call attention to Mr. Selous's 'African Nature Notes' in which there is an admirable discussion of protective coloration from first hand observation; and to Captain Stigand's 'Game of British East Africa' where the subject is also excellently treated.

natural selection. His assertion that concealing coloration is universal or nearly so, and sufficient to account for all coloration, is in flat contradiction of the facts as regards birds and mammals; I have shown that there are such sweeping exceptions to the principle, including thousands of species, as to make it impossible seriously to consider it as of universal or nearly universal application. There remains the doctrine of counter-gradation as the main factor in producing concealing coloration. Mr. Thayer deserves credit for pointing out the fact that counter-gradation of shades does (in some cases) help toward the obliteration of an animal's form. But his preposterous misrepresentation of the importance of his newly discovered principle destroys almost all the value of the conclusions he bases upon it. The countershading of a mammal's or bird's coat, when it exists (and it is often absent) is never more than a minor factor in concealing it and in the immense majority of cases is a negligible factor. In all probability the general shading of animals, darker above and lighter below, has nothing to do with natural selection or with concealing coloration, but is based on some such principle or law as that at work in the vegetable world which makes leaves darker on their upper than their under surfaces and similarly affects fruits. The fact that this law under certain circumstances tends toward concealment is of far more importance from the standpoint of the artistic colorist than from the standpoint of the naturalist or at least of the mammalogist and ornithologist; because in nature so many other elements enter into the problem that the working of the law is of practical effect in the cases of only a few mammals and birds. The countershading is not of concealing value where it translates itself into vivid colors of an advertising quality. Normally, birds and animals which are black above, are of an advertising coloration; and when the countershading assumes the form of snow white below it is advertising. Even if the countershading is gradual, it is of no use from the standpoint of concealment, if the general tint is out of harmony with the surroundings.

Taking all these facts together, it appears that as regards the great majority of birds and mammals, the countershading is of no concealing value, or else of a value so small as to be negligible. The only case where it is of concealing value is where the shading is gradual, and the change from above to below comparatively slight; and even then, only if the general tint is in harmony with the background and surroundings — which never can be the case if the change from above to below is either great or abrupt. Save in the limited proportion of cases which fulfil these requirements, countershading is a negligible factor in concealing coloration; and even in these comparatively few cases it is almost always of entirely secondary importance to the actual color.

So much for Mr. Thayer's especial theories. Now for the general subject

of concealing (protective) coloration. What I say is based on study of the mammals and birds of temperate and boreal North America and of tropical Eastern and Middle Africa. Doubtless what is true of these is true of other birds and mammals. Of the mammals, I have observed in their haunts, or have studied the skins of, most of those found in both countries; but of African birds I know only the waders, the swimmers, the birds of prey, the bigger land birds, and some of the more conspicuous smaller birds, such as some of the hornbills, nighthawks, swifts, swallows, sun-birds, bee-eaters, kingfishers, barbets, bulbuls, plaintain eaters, parrots, and whydah finches.

The first thing to realize in discussing concealing coloration is that to any but trained hunters' eyes, all birds and mammals out of doors seem far more inconspicuous than previous acquaintance with them in the museum or menagerie or in book pictures leads the observer to expect; and moreover when the mammal or bird is small, or is seen against the light, as must be the case where it is in the tree tops, the difficulty of making it out is immeasurably increased. Any man who has tried to photograph wild animals out of doors will realize how often he sees the animal at a range sufficient to warrant his shooting at it, and how rarely he is able by the utmost effort to get near enough to make a good picture of it. This, by the way, is one of the reasons, but by no means the only reason, why photographs, if not taken by men especially fitted to understand not only the uses but the limitations of their instrument, are so often entirely unsatisfactory and misleading as representations of nature. Even when taken close up photographs may give a completely erroneous representation of natural objects. Admirable work for science has been done of recent years by highly skilled naturalists and observers of nature who are also adepts in the use of the camera; but unless used by a very conscientious, and also very capable, observer, photographs may be a positive hindrance to knowledge.

The next thing to remember is that (entirely apart from the limitations of vision and observation of the ordinary man who is not a trained hunter,[1] that is, of the man who has not the eye of a bushman or of the most sharp-sighted wild beasts and birds) the difficulties of seeing any animal, merely because of the variety of the landscape, are far greater than most men, who have not thought out the subject, understand. There are landscapes that are almost flat monocolor; lakes and bare plains, for instance; and animals

---

[1] When I speak of a trained hunter I do not mean merely the ordinary hunter, with the ordinary power of reasonably good out-of-door vision, which most of us possess who have done a good deal of hunting or who have lived on ranches and out of doors. I mean the vision of the really wild hunters, like the 'Ndorobo with whom I hunted occasionally in the African forests, and who, I found, regarded not merely my vision, but the vision of my native Wakamba gun bearers, which was far superior to mine, as being immeasurably deficient.

on these, gulls or loons on lakes, and antelopes on the plains, are conspicuous. There are other landscapes, such as lawns thinly scattered with trees, where birds that do not try to conceal themselves, such as orioles and blackbirds, are conspicuous. But even in grassy plains or in marshes animals that pass their lives below the level of the grass tops or reed tops are very hard to see, and in forests the chance of an animal, even a conspicuous animal, remaining unseen, is very great. If the animal actually dwells in such thick cover that there are almost always physical obstructions between it and the sight of any possible foe, it escapes notice just as anything escapes notice behind a screen. If it does not venture out except at night, it escapes notice in the daytime for the very excellent reason that it is not where it can be seen; and at night, unless its color is white, it does not make very much difference what color it is. A multitude of mammals, especially small mammals, including most mice and shrews, come under one of these two categories; they are always either under the screen of night or under the screen of cover which shields them from view about as effectively as night does. But even where animals are diurnal in habit, and do not live in such thick cover as to be physically screened from all foes, a thick and high forest, especially a tropical forest, offers them extraordinary protection. Near the ground the light is dull, and among the shadows only very bright colors are conspicuous. In the upper branches the difficulty is just the reverse. There the myriads of leaves and twigs cause a well-nigh infinite variety of colors, lights and shades, and no small object stands out distinctly, as in the open. This is why the brilliant and abundant scarlet tanagers which dwell in the tree tops are relatively so very much more rarely seen than the Baltimore orioles around our houses, the bobolinks in the fields, and the red-winged blackbirds beside the ponds and swamps. In the forests the advertising colors do have some effect, and the male tanager is much more easily seen than a female tanager; but they have very much less effect than in the open. In consequence the birds and diurnal animals of the forest are difficult to see, no matter what their coloration, compared to what is the case on the plains. The same holds true of any accidented landscape: this is why it is often hard to pick out a pika in a mass of slide-rock, even though he may be really in sight and can be heard uttering his querulous note; and why in a varied mountain or hill landscape close scrutiny is necessary in order to see a marmot feeding, or a mountain sheep lying down, or a klipspringer going about his daily business.

Conclusions.

Keeping in mind these considerations we can tentatively draw the following conclusions as to concealing and protective coloration — and the most important of these conclusions are those which state the limitations of our present knowledge.

(1) Speaking roughly and generally, there is a tendency for certain general types of coloration to be found among all the birds and mammals affected by the same physical conditions. Those of the tree tops are apt to have a lighter, brighter, more varied coloration than those dwelling in the more sombre and uniform surroundings near the ground, beneath the forest trees. There is a tendency for arctic and alpine animals to be light colored and in many cases white, in winter; there is a tendency among desert animals to have very pale tints; there is a tendency for mammals and birds that dwell on or near the ground in thick forests to be dull colored; and animals of the semi-arid regions tend to be paler than those of cold or temperate humid regions, which tend to develop dark lusterless hues, as compared to the gorgeous hues so apt to be found where humidity and heat go together. There are multitudes of exceptions to all these tendencies, exceptions so numerous that it is out of the question to speak of the tendencies as laws that are always binding; and there are many areas where the types of coloration are so varied that it is impossible to state the case generally, the types of coloration being of what looks like haphazard incongruity, showing that many and conflicting principles of selection have been at work.

As regards this type of tendency, it is possible that it represents the result of natural selection picking out for the majority of birds and mammals colors which may conceal them. It is possible, and to my mind much more probable, that the major part of the tendency is due, as regards birds and mammals, not to natural selection for this purpose at all, but to the effect of physical surroundings upon all the individuals of a very great number of species. In any event there remain as to each locality many exceptions; that is there are in each locality many species, the coloration patterns of which have developed along directly opposite lines to those along which the coloration patterns of most of the other species of the locality have developed. Such exceptions include the musk-ox, raven and wolverine of the boreal regions; the cock ostrich and black and white chat among desert animals; the skunk, yellow-headed blackbird and lark bunting of the semi-arid regions of the United States: the tanagers, cardinals, and innumerable other birds in the moist temperate parts of North America. Moreover the general coloration tendency, where it exists, seems to affect

alike birds and mammals which might possibly be benefited by it, and birds and mammals which because of their nocturnal habits or for other reasons cannot possibly receive such benefit. The eagle owl of America, for instance, tends to be gray in the semi-arid region, and whitish toward the North; but its habits are such that it is impossible that these slight differences in its coloration can have any advantageous effect upon the individuals so colored. The same statement applies to the black duck-hawk of the Puget Sound region.

(2) There are certain birds and certain mammals whose coloration is unquestionably concealing, either for most of the time, or at certain vital periods, as when nesting, or, in the case of nocturnal birds, when crouching motionless during the daytime. Nighthawks and many grouse are striking examples of this. So, to a much less degree, are most rabbits, although these rabbits when in motion have a highly advertising rear-end coloration. All these animals deliberately strive to escape observation by remaining motionless. The chief factor in enabling them to do so, aside from cover, is their actual tint, whether uniform, or varied, or so minutely varied as to convey at a very short distance an impression of uniformity; but in some cases the concealing power of the coloration is probably slightly helped by countershading. These mammals and birds of unquestionably concealing coloration, where the concealing coloration is the principal factor in their concealment, are not many in number.

(3) Many mammals are advertisingly colored. This is true of many of the dog family, of most of the highly predacious weasel family, of many arboreal squirrels, and of very large numbers of the big grass-eating mammals. Some of these animals live in the open plain or on high mountains, and are very conspicuous and easy to see. Others live in thick forests and yet are exactly as hard to see as if they were obliteratively colored, because of their wariness and their ability to take advantage of the deep cover in which they dwell. Utility can have no part in developing such coloration patterns.

(4) Most small mammals, especially those of the forest and the thickets and the tall grass, have a coloration which can hardly be called especially revealing or especially concealing; they rely on the cover and on their habits, and not upon their coloration, for concealment. The utmost that can with any show of reason, be claimed as regards these is, that the law of natural selection, or whatever law it is that is responsible for their coloring, has set wide coloration limits, which the species cannot transgress, but within these wide limits has allowed each species to develop any kind of coloration pattern. It is of course very difficult to define the exact boundary lines separating the large classes of animals with a very slightly concealing or very slightly revealing coloration from the still larger class where

the coloration can scarcely be called either revealing or concealing. Many birds, such as many of the sparrows which live in the grass, are inconspicuous, and may be said to have a concealing coloration; and yet their close kinsfolk, with a substantially similar coloration, may live under conditions which make their coloration really possess little of either revealing or concealing quality.

(5) As regards the majority of birds and mammals the prime factors in securing their safety, are habit (including bodily capacity) if they do not trust to concealment, and habit and cover if they do trust to concealment. Among these birds and mammals the coloration is always a minor, and often a negligible, factor, and the countershading has no effect whatever, one way or the other.

(6) A large majority, probably at least three fourths or over of the birds of temperate North America, have coloration patterns which, either in whole or in part, either all the time in both sexes, or all the time in one sex, or some of the time in one sex, are advertising and not concealing. This is also true of those birds of Africa to which I paid attention, that is, the water birds, the bee-eaters, sun-birds, and the like. Often the female is concealingly colored or at least has a non-advertising coloration, where the coloration of the male is highly advertising. There are large numbers of birds, including various species of woodpeckers, crows, blackbirds, shrikes, flycatchers, swans, pelicans, herons, cormorants, gulls, guillemots, puffins and hawks which have in both sexes, and all the time, a strongly advertising coloration. In many other birds the coloration may be advertising, over the whole body, but only in one sex and for part of the year. In yet others the advertising coloration, temporary or permanent may be confined to one part of the body, such as the breast or head. The young birds may have a concealing coloration, even when the coloration of the parents is at all times, including the most critical moments of their lives, as when on the nest, highly advertising (as examples, take the skimmers, stilts, terns, gulls); or they may have a coloration as revealing, or almost as revealing, as that of the parents, this being true of pelicans, herons, cormorants, and anhingas, for instance.[1]

Among the ducks, ordinarily one sex develops strongly advertising coloration for almost all the year. The male cardinal has a strongly advertising coloration all the year. The tanager and bobolink have strongly advertising coloration patterns for part of the year. There are numerous other small birds possessing highly advertising patterns of body coloration.

---

[1] Photographs of the adults and young of all these birds are given in Mr. Chapman's 'Camps and Cruises', one of the most instructive and most delightfully interesting books of the kind that has ever been written.

There are still larger numbers of birds, including many sparrows and most warblers, where the males, at least in spring, possess a coloration which is highly advertising on certain parts of the body, usually the breast and around the head and neck. Taking all these classes together, they make up very much more than a majority of American species, each of which either all the time as regards both sexes, or, as regards one sex, for all the time or part of the time, are in whole or in part advertisingly colored. In the semi-arid West, for example, the male lark bunting has a plumage pattern which is advertising in its entirety, just as much so as a raven's; the male longspurs possess such an advertising pattern only on the head, neck and breast; whereas, for instance, the Baird's sparrow lacks it entirely, both sexes being similar and both seeking safety in actual physical concealment in the grass.

(7) These advertising colors represent several different principles or tendencies. As regards many of the crows, woodpeckers and blackbirds, it is evident that in the development of the different species, the tendencies, whatever they are, that have made for a concealing coloration, that is, for a coloration that would be in harmony with the landscape and the immediate surroundings of the birds, have been completely overcome by other tendencies that have acted with equal force on both sexes, or, if not with equal force, at least with sufficient force to make even the female, though perhaps less brightly colored, not concealingly colored. If, as in the red-headed woodpecker, where both sexes are alike, the bright coloration of the male is due to sexual selection, then either the same principle has been at work as regards the female, or else some other principle has affected both sexes in such a way and with such strength as to completely overcome any tendency to produce a concealing coloration. In the case of many ducks and tanagers, where, unlike what is true of ravens and red-headed woodpeckers, there is a strong sex difference, and where the male is much more advertisingly colored than the female, it is of course possible that the principle, whatever it may be, which is working for concealing coloration has been powerful enough to overcome any other tendencies as regards the female, but that the principle of sexual selection (or whatever principle it is which so frequently gives superiority in brightness of coloration, in ornamentation, and in bodily vigor, to the male) has been so strong as completely to overcome all tendencies that make for a dull or concealing coloration in the male. The white so common on the outer tail feathers of birds, which is only shown in flight, must represent a totally different tendency or set of tendencies; it is advertising; it is sometimes displayed in courtship; it may serve as a recognition mark when birds are in a flock; by its display in flight and its disappearance the instant a bird lights it may mislead a pursuer; and

of any pair of closely allied species, such as the vesper finch and savanna sparrow, or mockingbird and catbird, one may possess it and the other lack it, without any apparent difference in habits being produced thereby; while even in the same species, as in the robin, one form may possess these white markings, while another form lacks them.

(8) There are only rarely cases in which under the same conditions, all the kinds of concealing coloration tend to be of the same type. This is another way of saying, both that the principle of natural selection working towards a concealing coloration is in every case complicated by the workings of other principles and tendencies and also that even birds and mammals of comparatively restricted life-areas live under conditions of sufficient variety to make it impossible to develop coloration patterns showing such complete mimicry of their surroundings as are shown by the coloration patterns of certain insects and even reptiles. Under most conditions of bird and mammal life one pattern seems about as good as another if of the right general tint. Observers who get obsessed by their theory often pick out with triumph peculiarities which have no effect whatever, or even the reverse effect of that which they ascribe to them, and speak as if these peculiarities were essential to concealment. Thus it is alleged that the black tip of the ermine's tail, and the black tails of certain species of ptarmigan are concealing; yet the Arctic fox has no black tip to its tail, and there are white-tailed ptarmigan. It is evident that either the black on the tails of the weasel and of some ptarmigan has no especial effect, or else that the lack of it on the tails of the fox and of other ptarmigan, does have a special effect. If the black tail is concealing, then the white tail is revealing; and vice versa; or else no particular effect is produced either way. Doubtless the last is the case. Not only are minute patterns rarely of any real weight in concealing their wearers, but wide differences of pattern have no effect, if the general hue is one in sufficient harmony with the ordinary surroundings. This becomes apparent when we consider the utterly different coloration patterns of different sparrows, warblers and thrushes which live under substantially the same conditions and are equally hard to make out. A careful examination of those birds which really do have a concealing coloration, and may be beneficially affected thereby, goes to show that with the possible exception of a very few cases, it is out of the question that all the widely varying types of coloration, in any given set of surroundings, can have been produced by the same agency. In so far as the principle of natural selection, working toward the production of a concealing coloration, has affected all these numerous species of birds, it has done so, not by producing each of the countless and totally different types of coloration, but by setting bounds beyond which the coloration cannot vary in any adver-

tising direction, and allowing other circumstances to determine the exact pattern within these bounds. As already shown, countershading, among birds and mammals, generally plays an insignificant or negligible part in helping produce a concealing coloration.

(9) In many situations the quality of the landscape, or the quality of the cover, is such that neither any concealing quality in the coloration, nor any advertising quality, is of more than infinitesimal consequence to the animal compared with the development of other qualities — wariness, shrewdness, courage, speed, insistence upon living in the densest cover, or ability to take advantage of comparatively scant cover. A study of the big antelopes that live in the reeds, and of the big and small antelopes that live in the jungle, and of most of the birds of the tree tops, will show that in all these places with very thick cover, or with varied cover, concealing coloration plays little or no part; for the animals that do not possess it thrive as successfully as those that do.

(10) It is easy to understand that advertising and concealing coloration should alike be indifferent to animals that live in such cover as to hide both them and their coloration. But many mammals and birds live absolutely or practically in the open, or under conditions where advertising coloration does in fact advertise them at a much greater distance than would be the case if they lacked it; and yet even under these conditions hundreds of species of a highly advertising coloration prosper as well as, although apparently no better than, those with a concealing coloration. Gulls, cormorants, loons, grebes, guillemots, fulmars on the water; herons, storks, ibises, plover on the plains, or the edges of marshes, lakes and rivers; big antelope and zebra on the plains; blackbirds, grackles and bobolinks in the meadows and pastures; all illustrate this fact. The numerous species of bee-eater which I saw in Africa all had an intensely advertising coloration, and lived under conditions which accentuated the advertising quality of the coloration. The topi, with its very bold and inversely countergraded coloration is no more nor less at home in the places where it dwells than is the countershaded eland with its much less conspicuous coloration. A male Grant's gazelle which is countershaded and not very advertisingly colored, is no less and no more at home than the female of the same species which has an advertising black stripe along the body, or than the smaller Thomson's gazelle, which also has the black stripe, together with the habit of perpetually twitching its tail whenever it is standing up. The yellow-headed blackbird has an extraordinarily advertising coloration; but I cannot see that it affects the welfare of the species one way or the other.

Among certain species of birds, however, there is a contrast in the behavior of those that are advertisingly colored and those that are not.

On the plains, thrashers always skulk and seek cover in which to hide, while blackbirds, which of course are infinitely more conspicuously colored than the thrashers, walk and sit boldly in the open. The meadowlark which has a highly advertising breast coloration, but a concealing back coloration, skulks and takes advantage of cover in a way which the robin never does. On the other hand there are other cases where birds that are concealingly colored take no advantage of their coloration and behave exactly as do their kinsfolks that are advertisingly colored. The kingbirds, and especially the scissors-tailed flycatchers, are very conspicuous, and are good examples of advertising coloration, when in their ordinary surroundings. Most of their near kin, the phœbes, are inconspicuously colored; but neither the phœbes nor the wood pewees seem to take advantage of their coloration in order to try to conceal themselves. Most of the small flycatchers do live in thickets, where their inconspicuous coloration may be of benefit to them; but the great-crested flycatcher, which is colored substantially like the Western kingbird, is unlike the kingbird in its habits, and at least sometimes seeks to take advantage of cover. There are innumerable instances of this kind.

(11) In short, as one might anticipate, when we deal with the coloration of birds and mammals we deal not with any one cause, but with a varied and complex tissue of causes. Forces have been at work to develop concealing coloration in many species, and countervailing forces have worked with greater or less strength to counteract the influence of the first, in some species completely succeeding and in others partially succeeding. Some birds and mammals are so colored that normally or at certain important times their coloration helps to obliterate them from the sight of their foes. Others are so colored that their coloration under all normal conditions and from every viewpoint, and at the most critical periods of their lives, tends to reveal them to their foes. In others the coloration is of little consequence, one way or the other. Birds and mammals living under precisely the same conditions have totally different types of coloration, and display totally different traits and habits when seeking to escape from enemies or to capture prey. No universal laws can be laid down. Tentatively, it is possible to give adherence to the conclusions which I have sketched in loose outline above. We know that many birds and mammals are concealingly colored. It is hard to say, at least in some cases, whether this concealing coloration has been produced by natural selection, or whether, however produced, it has merely then been taken advantage of by the animals, which have conformed their habits thereto, so as to get the utmost benefit from it. In many birds and mammals sexual selection or some similar principle has completely obscured in one sex the workings of the law which tends to produce conceal-

ing coloration. In many other birds and mammals both sexes are advertisingly colored, and whatever be the cause that has produced this advertising coloration it is evident that the circumstances of their lives are such, that their habits and traits of mind are such, as to render the question of concealing coloration a negligible element in their development.

The species of birds and mammals with a complete obliterative, or concealing, or protective, coloration, are few in number compared to those which possess (either all the time, or part of the time, or in one sex for all the time or part of the time) a conspicuous or revealing or advertising coloration, and to those in which the coloration is neither especially advertising nor especially concealing. As regards the great majority of the species, the coloration, whether concealing or not, is of slight importance from the standpoint of jeoparding or preserving the bird's or mammal's life, compared to its cunning, wariness, ferocity, speed, ability to take advantage of cover and other traits and habits, and compared to the character of its surroundings.

So much for the conclusions to which, it seems to me, our present knowledge of the subject points. But the most important conclusion is that as yet we do not know enough to be able to explain all, or anything like all, the different kinds of coloration and their probable origins; and that we are not as yet by any means in a position to say with any certainty, in reference to large classes of birds and mammals, whether they do or do not possess a concealing coloration. We can say with certainty that hundreds of birds and mammals possess a revealing, and other hundreds a concealing coloration; after even a slight effort to look at the facts honestly there is no doubt on this point; and, after such effort has once been made, it is as idle to discuss whether for instance flamingoes, spoonbills, ravens, egrets, red-headed woodpeckers, scissor-tailed flycatchers, yellow-headed blackbirds, cormorants, prongbucks, skunks, sable antelopes, are concealingly colored, as it would be to discuss whether the world is flat, or whether every extinct and existing "species" came into being by a special act of creation.

But there is room for wide differences of opinion as to how great the part played by concealing coloration is, so far as multitudes of other birds and mammals are concerned. Many skilled field ornithologists of great experience — men like Mr. Chapman, for instance — for whose judgment I have the most unqualified respect, believe that concealing coloration is far more widespread, and plays a much more important part than I have admitted. I believe that it plays a large and important part; I believe that there are many cases where it is a main factor, in helping the wearer

in the struggle for life, and a far greater number of cases where, although not a main factor, it yet exercises an appreciable influence; but I believe that on the whole, among birds and mammals, the main factors are, first and universally, habit, and, second and by no means universally, cover. Whether the part it plays is larger, even very much larger, than I am at present prepared to admit must be determined by the studies of many such first-class observers as Mr. Chapman, Mr. Job, Mr. Finley, Mr. Beebe, Mr. Kearton. Take for example the descriptions and photographs of waterbirds by Messrs. Chapman and Job; no one can look at the photos of the black skimmer and stilt on their nests without seeing that even in that critical position their coloration is highly advertising, while the coloration of their young is concealing; no one can look at the photographs of the nesting egrets, anhingas, cormorants and pelicans without seeing that both the adults and the young are exceedingly conspicuous, without a vestige of concealing coloration; no one can look at the photographs of the nesting woodcock, nighthawk, Wilson's snipe, bob-white, and upland plover without seeing that they possess a concealing coloration. In the same way, I think that the conclusions, based on prolonged and careful personal observation, which I have reached as regards the larger carnivores and game animals, of North America and Africa, as set forth in this paper and in the appendix to my 'African Game Trails,' cannot be successfully controverted. The problems in these cases are comparatively simple. There are many more obscure problems; such as the determination of the parts respectively played by habit, cover and coloration in concealing, or favoring, minks, weasels, rabbits, meadow mice, warblers, finches, titmice, vireos. I believe that the general conclusions which I have above set forth are, within broad limits, correct; but no one will welcome more heartily than I shall the conscientious and exhaustive study, of the many groups of birds and mammals, in their own native haunts, under natural conditions, which will finally enable naturalists to say just what these limits are.

APPENDIX.

Reply to Criticisms of A. H. Thayer in 'Popular Science Monthly' for July, 1911.

In the July 'Popular Science Monthly' Mr. Thayer has an article in answer to the appendix (as he calls it, the "extraordinary tirade") in 'African Game Trails,' on the subject of concealing coloration. Mr. Thayer's habit of mind is inaccurate; and his inability to be accurate in matters biological extends also to inability to quote correctly what I have written. Thus he makes a diagram to show that I am "exactly wrong" in my (purely imaginary) statement "that to the lower-levelled eye of a wolf or cougar a prongbuck's white rump shows now against the sky and now below it, according to the enemy's distance." I made no such statement; I suppose that Mr. Thayer's attributing it to me must be pardoned in view of his "artistic temperament," which, in ascertaining facts, he exalts so far above the scientific. What I actually said was that Mr. Thayer's theory could be sound only on the supposition that the wolf or cougar "never glanced in its (the antelope's) direction save at just the one particular moment" when "it happened to be standing stern-on in such a position that the rump was above the sky line and all the rest of the body below it. Ten steps further back or ten steps further forward would in each case make it visible instantly." This is true; so true, that Mr. Thayer cannot refute it, and therefore attributes to me a statement which I did not make in order that he may get something which he can refute. Mr. Thayer's theory — an absurd theory anyhow — could have value only on the supposition that the wolf never looked at the prongbuck save when the animal stood absolutely end on to him, so that the rump concealed the entire fore part of the body; and I was pointing out this fact. This is wholly aside from the fact that the prongbuck usually lives in a somewhat rolling country, so that in actual life it is more apt to be seen against the landscape than against the sky line; and when approached in a rolling or broken country, or of course where there are bushes or trees, the antelope or deer must necessarily often be seen at a distance against a background of bush or hill, even though when looked up to from close by it would be seen against the sky. Again Mr. Thayer states that when I said that "bears have no white on them" I erred because several foreign species have (as of course I well knew). A glance at my appendix will show that Mr. Thayer must have known perfectly well that I was speaking of our common skunks as compared with our common bears. My statement as to these was minutely accurate. I was comparing animals with white and animals without white; the point I was making was wholly aside from, and had nothing to do with, the different coloration of bears, and of skunk-like animals, in other continents (although I could also have made the same point by considering these). Again, Mr. Thayer states that I said that there was "never any difficulty in seeing" game which was hidden from me by "a haze of interposed scrub growth," which at some point was "wholly covered by the scrub," was "actually hidden by accumulated twiggery." This is a rather flagrant instance of giving full rein to "an artistic temperament." I never said anything of the kind; either Mr. Thayer

knows this, or he knows nothing of any game country. I was contrasting the bush antelopes, which do elude observation and are difficult to see, with the antelopes of the bare, open grassy plains of East Africa where there is no bush, no scrub, no twiggery, no cover; and of this game of the bare plains I said "On the open plains.... there is never any difficulty in seeing (the game); the difficulty is to prevent their seeing the hunter." This is the exact fact. Mr. Thayer would not need to be told that such is the case if he had the slightest knowledge of the conditions of the African wild life concerning which he dogmatizes so glibly. Any naturalist or hunter accustomed to accurate observation who has been in East Africa will accept the statement as a matter of course; and if Mr. Thayer will turn to such a book as Captain Stigand's he will find the fact stated again and again. In the ordinary bush I found all game difficult to see and in the thick forest I found it almost impossible to see; the forest hog and bongo are hardly ever seen by white men, and even in their less densely wooded haunts the bush pig and bush buck must be carefully and skilfully looked for; whereas the plains game can be seen by anybody who crosses the plains, even in a railroad train. The veriest tyro who rides across the Athi or Kapiti plains, or in the Sotik country, or along the Guaso Nyero of the north, or in the neighborhood of Sergoi Hill, cannot help seeing the zebra, oryx, hartebeest, topi, and wildebeest. If he is a good hunter he will see practically all of these animals that are to be found in any locality he is hunting. In each camp in which we stayed for any length of time we soon grew to know most of the different herds of game on the plains in the neighborhood, and indeed some of the individual animals; for we generally found that each herd or individual had a certain beat in which it was apt to be found. If he will turn to Mr. Chapman's 'Camps and Cruises' Mr. Thayer will see that Mr. Chapman has stated the same fact, for our own western plains, even more strongly than I have done, stating that every antelope, coyote, fox, badger and gopher is visible on the bare, grassy, open plains, whereas it is impossible to find out just what animals a square mile of forest contains.

It ought not to be necessary to tell such simple and elementary facts to any man who writes a book of such pretentiousness as Mr. Thayer's. I have given samples only of the way in which he misrepresents what I have said. It would be pointless to multiply the instances.

Now, take what is much more important, Mr. Thayer's effort to prove the truth of his theories that flamingoes, male wood ducks, male bobolinks, zebra, oryx, etc., are concealingly colored. All I need say as to the wood duck is to refer to what I have already written in this article. But Mr. Thayer advances some new ideas as to the zebra and oryx. He protests against my alleged statement that "if one coloration is a concealer, a different one in an animal of the same general habits is not." As usual Mr. Thayer suffers from his inability to state facts correctly. What I really said was "The beasts above enumerated (zebra, wildebeest, topi, hartebeest, oryx, eland gazelle) are colored in widely different fashions. If any one of them was really obliteratively colored, it would mean that some or all of the others were not so colored." This is the exact truth. Any animal of any color if it keeps still may under certain conditions escape detection; and most birds and mammals seem to know this, for from elephant, rhinoceros, buffalo and bear down to field mice and nesting warblers and vireos they all at times "freeze" or stand motionless, their immobility thereby giving them a chance to escape observation no matter what may be their size, shape or color (I have seen all the four big creatures above mentioned, which even Mr. Thayer admits not to be concealingly colored, stand motionless

to escape the notice of the hunter, just as I have seen timid animals with concealing coloration patterns stand motionless for the same purpose). Moreover, there may under certain conditions be several styles of coloration each of which can fairly be called concealing; but if of several coloration patterns each is in direct and striking contrast to one or more of the others, they cannot all be concealing under the same circumstances. A drab, a dull gray, a dull greenish brown, a dull yellowish brown, may all be concealing, not because one is somewhat yellowish, another more greenish, another more brownish, but because all are dull; but if the surroundings are such that a vivid red is concealing, then a deep blue or a brilliant white cannot be — for if they all escape notice it simply means that the surroundings are such that no color can attract attention, and therefore that no color is either concealing or revealing. If an animal is concealed because of the fact that it is black, then its mate, if yellow brown, cannot be concealed because of the fact that it is *not* black. A male Grant's gazelle, a roan, an oryx, an eland, might under certain circumstances be considered all to have concealing coloration, because, although not colored exactly alike, their general body tints have a certain likeness; but if this is so, a sable, a pallah, a wildebeest, a topi, a hartebeest, a zebra, colored one black, another red, another purplish, another brindled slate, another black and white, cannot all of them — or any of them — also be concealingly colored. If under precisely the same conditions one animal is concealed because it *is* striped, another cannot owe its concealment to the fact that it is *not* striped; all that can be said is that under such circumstances the stripes do not count one way or the other, being neither concealing nor revealing, or else that, if one phase is concealing, then that the other is revealing.

Mr. Thayer begins his article by giving an experiment with "a small stuffed deer that wore from its dorsal line down its sides two white stripes in imitation of those of certain African antelopes. These stripes were in every respect such as Theodore Roosevelt says have no concealing virtue of any kind whatever." (Incidentally I cannot find such a statement by me in the article to which he refers, and therefore do not know what particular kind of stripe he supposes I had in mind.) He states that at ten yards' distance these stripes rendered the deer invisible to "forty naturalists"; but that when these white stripes were removed and the deer left colored as it actually was colored by nature, "the spectators exclaimed at how clearly one could now see the deer." Apparently neither Mr. Thayer nor his "forty naturalists" appreciated the most significant feature of his exhibition, which was that (if his experiment was exactly as he describes) *he proved that the actual coloration of the deer was not concealing, and that it had to be concealed by giving it a coloration it did not actually possess.* In other words, Mr. Thayer proved that natural selection had *not* given this deer a concealing coloration, that its coloration was not such as to give it the most protection possible (and therefore that concealing coloration played an unimportant part in its life compared to other factors — such as habit and cover). If neither Mr. Thayer nor any of the "forty naturalists" saw this obvious fact, then it is evident that both the artistic temperament and the scientific temperament at times stand in urgent need of being based on a foundation of common sense.

In Sclater and Thomas's 'Book of the Antelopes,' some 120 African antelope are given, of which about 12, all but one of them tragelaphs, are in some fashion striped. Now if Mr. Thayer's experiment proves anything (aside from the fact that nature did not furnish a concealing coloration to the animal experimented upon, and that

Mr. Thayer had to step in and supply the omission) it is that the *absence* of stripes advertises the antelope; which would mean that he had shown that nine tenths of African antelope, big and little, bush dwellers and plain dwellers, were by his own standards advertisingly colored. I know nothing as to the kind of stripes he used, nor as to the kind of African antelope he made believe that he was imitating — I have never seen one with only two white stripes such as he describes. The eland and bush buck were the striped antelope I had a chance to study when wild. Ordinarily the eland lives in the bare plains, where it is conspicuous. The East African eland has thin stripes; the South African eland, so closely kin to it as probably to belong to the same species, has no stripes; both have exactly the same habits, live under exactly the same conditions, have exactly the same foes; both, in a state of nature, prospered equally; neither is either revealed or concealed by either the presence or the absence of the stripes. At times, in bush, the eland and the roan are both difficult to see, partly, doubtless, because their general coloration harmonizes with that of the dry landscape; but neither the absence of stripes in the roan, nor their presence in the eland, makes any difference in this case, as I can testify from personal observation in the field. It is therefore absurd to lay any stress one way or the other on the fancied concealing quality of this particular feature of the animals' coloration; but it is essential to keep in mind that if Mr. Thayer is correct in saying that one form of eland is concealed because of its stripes, then the lack of stripes must be a revealing feature in the other, as well as in the roan, the oryx, the hartebeest and the gazelles which are found in the same habitat with the striped eland. This of itself would be fatal to Mr. Thayer's theory, which is that *all* animals are protectively or concealingly colored. So with the bush buck as compared with the unstriped dyker, steinbuck and reed buck, one or all of which I have almost always found dwelling in the same cover with it. The steinbuck, dyker and reed buck are colored substantially like Mr. Thayer's "small stuffed deer" which he says in the natural coat could be so "clearly" seen. Mr. Thayer's experiment therefore, if it proves anything (which as a matter of fact it does not), proves that most deer and antelope are "clearly" visible, and only a small fraction concealingly colored. The bush buck changes from a bright tropical form much striped and spotted to a dark south African form in which the male has practically lost these bands and spots (just as the southern forms of the eland and zebra, or quagga, lost, in one case all, in another case almost all, of the striping); and the animal remains just as hard to see in one case as the other.

Mr. Thayer then says that the trouble is largely because I "carried into Africa the regulation down-looker's misconception of the subject. . . . Man is mainly a looker down. . . . he hunts. . . . largely or wholly looking downward." This statement is simply not so. Except when tracking, a big game hunter in Africa or elsewhere is not often looking down, and is continually looking far ahead and around him; and from a distance in looking at a big antelope the effect of the difference in level between a man's eyes and a lion's eyes disappears. Nor is this all. In the actual stalk the hunter generally advances crouching, or on all fours, or wriggling flat on the ground; so that at the "crucial moment," of which Mr. Thayer speaks as the one for which the animals' coloration is designed, the hunter is apt to be looking up, just exactly as one of the animal's natural foes would be looking up. Except at these moments lions and tigers look up so rarely that a man in ambush in a tree usually escapes their observation; and at the crucial moment they look up only as the hunter at such a moment is apt to look up. Mr. Thayer says that he has been

wholly unable to convince naturalists of the importance of looking up at animals or to get more than an occasional man ("scarcely one man") to lie on the ground so as to "let this immense fact rush upon his consciousness." If he had ever in his life taken the trouble to talk with the right type of a big game hunter, or field naturalist he would have found that the "immense fact" referred to was a matter of familiar knowledge to the hunter or naturalist, merely because he as a matter of course is continually lying on the ground and looking upward, or looking at animals from a distance such that his angle of vision is exactly that of a wolf or cougar.

Mr. Thayer in this article takes up the zebra and oryx. As to the zebra he has abandoned much of the attitude he took in his book. He no longer speaks of the zebra's coloration as being "effectively obliterative at a great distance"; on the contrary he says that "out in the open, the zebra's watchful eye and ear, backed by his agility, ensure his safety." He no longer says of the zebra as he comes to drink that "from far or near the watching eye of the hunter (bestial or human) is likely to see nothing but reed-stripes"; on the contrary he says "the crouching lion sees him come into the reeds — sees him all the time — and if the zebra comes within range, springs upon him, but. . . . has inevitable difficulty in distinguishing the zebra's outlines because of the absolute similarity of the zebra's imitation of reeds and sky to the real ones. The zebra's uneasiness keeps both the real and the counterfeit in motion together. . . . the lion's. . . . second spring. . . . must be guided by a lightning-swift perception which of the violently agitated sky-and-reed-stripes are the zebra and which are not." Mr. Thayer knows nothing whatever of the zebra's habits or looks in nature, and has evolved his successive theories purely from his inner consciousness; and, as it happens, he has merely shifted from one absurdity to a worse absurdity. When a moving zebra is so close that a lion can spring on it there is not one chance in a thousand that the lion will mistake the moving zebra for a "sky-and-reed-picture"; why, I have never known such a thing happen even to a dull-sighted white hunter. Every action of the lion and every experience of the observant hunter go to prove that when the zebra is moving, close by, the lion does not and cannot make such mistakes as Mr. Thayer supposes; a lion of such dull wit and sense would starve at once. Nor is this all. Here, as with his striped antelope, Mr. Thayer proves too much. If the zebra is concealed by his stripes at his drinking place or elsewhere, then the wild ass (an unstriped zebra) must be revealed by his lack of stripes; Mr. Thayer ought to show his sincerity by admitting such facts as this, which he cannot deny and so merely avoids discussing. Moreover, the zebra is intimately associated with the hartebeests, wildebeests and oryx, all of which have the same habits, and the hartebeests are even more plentiful throughout the greater part of the zebra's range. If the zebra's stripes conceal him at the "crucial moment" of his life, as Mr. Thayer contends, then at this same crucial moment the hartebeest is revealed by the dark monochrome of his upper body; so is the wildebeest, so is the topi. Mr. Thayer's theory is self destructive.

Mr. Thayer gives half a dozen pictures of an imitation oryx head to prove that the bold head markings of the oryx conceal it at the "crucial moment" when it is going to drink. The pictures show "an imitation oryx head, looked up at, simulating branches against the sky — as at a reedy drinking place it would simulate reeds," and also a "brown countershaded" antelope's head; "the former inconspicuous, the latter less so," and in another picture the former "hard to distinguish. . . . against the sky," the latter "very conspicuous." In the first place it would be well to know which sky Mr. Thayer means; his deep blue sky which matches a peacock's neck,

or his pure white sky which matches a prongbuck's rump; they cannot both act concealingly to the head of the oryx. Moreover, there are two flagrant follies in the theory illustrated by this set of pictures. Most antelopes which lead similar lives to the oryx — the topi, wildebeest, hartebeest, eland — actually possess the very type of head coloration which he admits to be conspicuous; so that if his belief were true, he could only show that the oryx had a concealing coloration by admitting that a dozen other antelope had revealing coloration patterns — which would of course destroy his whole theory, for the number of antelope with "brown counter-shaded heads" which have the same habits as those with oryx-like markings on the head far outnumber the latter. But the idea set forth in the picture is shown to be foolish by a moment's consideration of the fact that neither the oryx nor any other antelope stands motionless at a watering hole. The very fact of coming down to drink implies motion, and motion in such a case instantly takes away all concealing power from any coloration. I have often watched antelopes coming down to drink; and Mr. Thayer has not the slightest idea of their habits, or he would never advance such a theory. After coming to drink they at once leave, never lying down or resting at the drinking place. About the zebra, Mr. Thayer has at least learned this elementary fact; but he forgets it again as soon as he becomes obsessed with the thought of a new puzzle picture with the head of an oryx as the subject. An oryx or other antelope with similar habits approaching to drink alternately moves and halts, and is most of its time in the open; and the lion or leopard lying in wait could not possibly fail to see an animal thus approaching, so that the marking on its head could by no chance have any effect whatever in puzzling or deceiving its foe. Its movements would have betrayed it as soon as it came anywhere near, and it would never again have been hidden from the lion or leopard. Photographs such as these of the imitation oryx heads are no more useful than would be a photograph of a stuffed bear, arranged sitting upright among burnt stumps so as to show his "concealing coloration" and protective resemblance to a stump. Any animal's head seen through branches may be difficult to make out and any such head can be posed so as to make it difficult to see; but so is a bear difficult to see among stumps, and by no means unlikely to be mistaken for a stump (as I have seen happen). Such incidents teach no real lesson and when manipulated by Mr. Thayer teach the exact reverse of the truth.

All this moreover is aside from the fact that in the great majority of cases the lion kills by night, when the exact coloration of his prey is of very little, or absolutely no effect. Mr. Thayer always assumes that the beast of prey invariably looks *up* at its prey. As a matter of fact it usually only looks *up* at the last moment, when it is so close that it cannot possibly be misled by any of the so-called concealing marks; at a distance it looks at its prey practically from a level, its viewpoint being then practically the same as that of a human hunter.

Mr. Thayer says that concealing coloration does not primarily help an animal when it is trying to hide; but on the contrary, "the more an animal does not hide, the more nature has to help him by coloring, precisely as in the case of the zebra at the drinking place, or the hummingbird with his head stuck into a flower, or the flamingo at dawn with his head in the mud." This is equivalent to saying that Baltimore orioles, blackbirds and crows which don't hide, are more concealingly colored than grass sparrows and woodcock and snipe, which do hide. There is scant need to refute such a proposition. In the great majority of cases concealing coloration only benefits the animals which, by remaining motionless or skulking

allow it to come into play. This is true even of different individuals of the same species; an advertisingly colored adult nesting skimmer or other similarly colored water bird never tries to hide itself, whereas the concealingly colored young crouch motionless on the sand so that their coloration may help them when they are trying to hide. Of course if natural selection, as Mr. Thayer supposes, produces concealing coloration, it must also produce the power to take advantage of it, or the animal would derive little benefit from it. Zebras and flamingoes I discuss in this article; since I have been writing it a hummingbird outside the window has been "sticking his head into a flower" and the iridescence on his back, his vibrating wings, and his hum, made him so conspicuous that no creature with eyes and ears could possibly have failed to notice him; while in the dark caused by his head in the flower the little insects therein could n't possibly have told whether he was or was n't iridescent about the head (according to another of Mr. Thayer's child-fairy-story theories).

Instead of considering animals which have not concealing coloration, consider for a moment those that have. Doubtless coloration sometimes helps a fleeing or dodging bird or mammal, but normally the great benefit comes to the animal which is motionless. A cock prairie hen, at the love ring, squats motionless as a hawk comes near, losing every particle of his previous conspicuousness, and profiting by all the concealing coloration he has, so as to hide from the vision of his foe. The mother grouse on the eggs hides in just the same way, with the same consciousness. So does a squatted nighthawk. A squatted deer or antelope is certainly consciously trying to hide; the instant it catches the hunter's eye it bounds off, at once abandoning, and losing all benefit from, its concealing coloration. Mr. Thayer's position is wholly incorrect and indefensible.

It is hardly worth while to discuss all of Mr. Thayer's statements, such as his assertion that no man knows anything of the "laws of optics" who believes that the white of a prongbuck or skunk makes the wearer more apt to be visible at night than are animals which lack white. Last night under the "clear moonless night sky" which Mr. Thayer demands, I took out into an open field, and then among trees, a black cloth, a brown cloth, and a white towel about the size of a prongbuck's rump pattern. I hung them on a wire fence and then on tree limbs above my head; I looked at them from below and from one side and from every angle and from above. Against the sky line, especially when seen from below, the differences among them were least; and under certain conditions, of course, none of them could be seen at all; but the white did *not* ordinarily fade into the sky line (exactly as I had already said, from my experience with living animals); it was conspicuous when seen from below at the distance of a cougar's spring; it was by far the most conspicuous of all the colors when seen from below against a hillside or a bush or tree; it was by far the most conspicuous color when seen from the same level, as prowling beasts of prey generally first see their game. Every statement I made about the white on prongbucks or skunks was exactly borne out by these observations. Black, under certain conditions, is more visible at night than dull yellowish brown. Under most conditions and against the largest number of backgrounds, white is on the whole, at night, very much more conspicuous or revealing than any other color; taking together moonlight nights, and nights without the moon, and all the various cloud effects. The black and white stripes of the zebra merge into a monochrome at a few hundred yards in the bright day, and at a few dozen yards in the late evening; in the moonlight I have seen zebras show as if they were a uniform silvery white; but normally at

night, when I could seen them at all, even when very close, they seemed rather formless shapes of the same indistinct shade as any other beasts at that time. When *very* close up the white of the stripes doubtless glimmers dimly, and then has a very slight advertising value.

On this point, as on so many others, it is difficult to argue with Mr. Thayer because of the utter absurdity of his position. There is no need of knowledge of the "laws of optics" in order to realize that on the whole white is the most revealing color at night, if the conditions are such that any color can have any revealing effect at all. Every out of doors man knows this and shapes his conduct in accordance with this knowledge; and failure to realize it denotes, not "knowledge of the laws of optics" but inability or deliberate refusal to observe ordinary facts and to understand and apply them when observed.

Mr. Thayer says that the breeding cock bobolink has a "potently obliterative dress" from the hawk's viewpoint. As the bobolink when breeding sings continually, from telegraph poles, low posts, small trees, on weeds, in the air, and on or near the ground, a man is quite as apt to see him from below or to one side as from above, and therefore is apt to see him from several of the usual viewpoints of hawks (excluding the soaring buzzards, which are least dangerous to him). Moreover if the coloring of his upper parts obliterate him in the view of hawks, then the lack of such coloring in the cow buntings, purple and rusty grackles, yellow-headed and red-winged blackbirds, must advertise them, for they are all birds of habitually the same surroundings; so that Mr. Thayer has merely again fallen into one of his most common and rather comical errors. As a matter of fact the males of all these birds in mating plumage are extraordinarily conspicuous, and never more so than when seen from above against their ordinary backgrounds, the viewpoint of the hawk of which Mr. Thayer speaks.

Among all the wild absurdities to which Mr. Thayer has committed himself, probably the wildest is his theory that flamingoes are concealingly colored because their foes mistake them for sunsets. In this article he solemnly reiterates and expands this belief; and incidentally, as showing that they are most apt to be seen at the water's edge at sunrise and sunset, he advances the old idea that the flamingo is nocturnal, apparently not having taken the trouble to read Mr. Chapman's book in which it is shown that they feed both by night and by day. As with so many of Mr. Thayer's theories, there is a certain difficulty in meeting this, merely because of the fact that it is utterly absurd. It is difficult to meet a statement of what is against the evidence of the senses by an appeal to the senses; there is absolutely no use in arguing with a man whose mind is such that he is capable of making such a statement; but when he is accepted seriously by people who ought to know better, who ought to understand something of the worth of accurately observed facts, and of rational appreciation of the value to be put upon, and the deduction to be drawn from, observed facts, it becomes really necessary for someone, however reluctant he may be to hurt Mr. Thayer's feelings, to show just what Mr. Thayer's guesses and "experiments" amount to. Remember that he has never studied flamingoes in their haunts, he knows nothing personally of their habits or their enemies or their ways of avoiding their enemies (I suppose — although it may be a violent supposition — that even Mr. Thayer does not imagine that the small gasteropods and other little creatures of low organization on which the flamingo feeds mistake it for a sunrise or sunset) and certainly has never read anything to justify his suppositions; these suppositions represent nothing but pure guesswork, and even to call them guesswork is a little

over-conservative, for they come nearer to the obscure mental processes which are responsible for dreams. He speaks of my having written of a flock of flamingoes "looking like a pink cloud" as if it were a kind of justification of his theory; I have also often spoken, as so many, many men and women have spoken, of the bluebird's back as being like a patch of sky, and he might just as well treat this as an admission that a bluebird is concealingly colored because a hawk may think it a patch of sky which has fallen to the ground. One supposition is no wilder than the other. Mr. Chapman studied the breeding habits of the American flamingoes which live on islands on the ocean and feed in water so shallow that they can hardly be attacked by either sharks or alligators. The flamingoes we saw in Africa lived in the interior of the continent. I saw a few on Lake Naivasha; but my son saw enormous numbers of them at Lake Hannington, and carefully studied their habits. He did not find them breeding. They were extraordinarily conspicuous birds. The adults were red, the color being most vivid when they spread their wings; the well grown young, almost or quite as large as the parents, were white. They spent their time standing on the grassy or muddy flats, feeding in the shallows, and floating — swimming — in the lake, usually in the shallow parts, but often in the middle, where it was deep. They were occasionally found in small parties, but usually in huge flocks and very rarely singly. They were to be found feeding at all times, more or less, but most commonly in the morning, up to ten or twelve o'clock, and again in the late afternoon and evening. Unlike herons, when they fed they were always moving, and in any flock which was feeding there was always motion, so that at any reasonable distance no creature with eyes, no creature capable of seeing them at all, could by any possibility fail to distinguish what they were, or mistake them for clouds, or sunrise, or sunset,— a supposition so ridiculous that I am ashamed even to repeat it,— or anything inanimate. They were extraordinarily conspicuous, whether seen from below, from above, or from one side, and the angle of vision made no difference in recognizing them (this I found to be the fact myself). When floating in companies on the water they often seemed motionless, and also when drawn up in companies on the grassy beaches or mud flats. Now the extraordinary thing was that Lake Hannington abounded not only in hippos but in crocodiles; and in driving their herds and flocks to drink at the inlet the natives had to exercise much care to protect them from the crocodiles. In Lake Naivasha there are no crocodiles, and it swarms with geese, cormorants, pelicans, ducks, gulls, coots, and herons (all of which I have also found swarming in lakes containing crocodiles); yet from time immemorial, since the days long before the advent of the white man, the flamingo has frequented Lake Naivasha only in small numbers, and has swarmed in and around the brackish crocodile-infested waters of Hannington, and not only feeds in the shallows to which a crocodile cannot penetrate, but in shallows with so much water as to be easily navigable for crocodiles, and moreover floats in companies for hours at a time, at noon and in the morning and afternoon, in waters amply deep enough to be the regular haunts of the sinister reptiles. Throughout the day, of course, there is no sunrise or sunset for the huge pink birds to resemble — aside from the fact that the full grown young, not yet in the adult plumage, are white, although if there were any concealing virtue in red they would certainly need it more than their experienced parents. I can give no explanation, unless it be found in the birds' intelligence, wariness and keen senses, of how they avoid crocodiles. But it certainly cannot be because of any concealing quality in the flamingo's gorgeous plumage. In the waters in which crocodiles live we found myriads of brown geese, brown and parti-

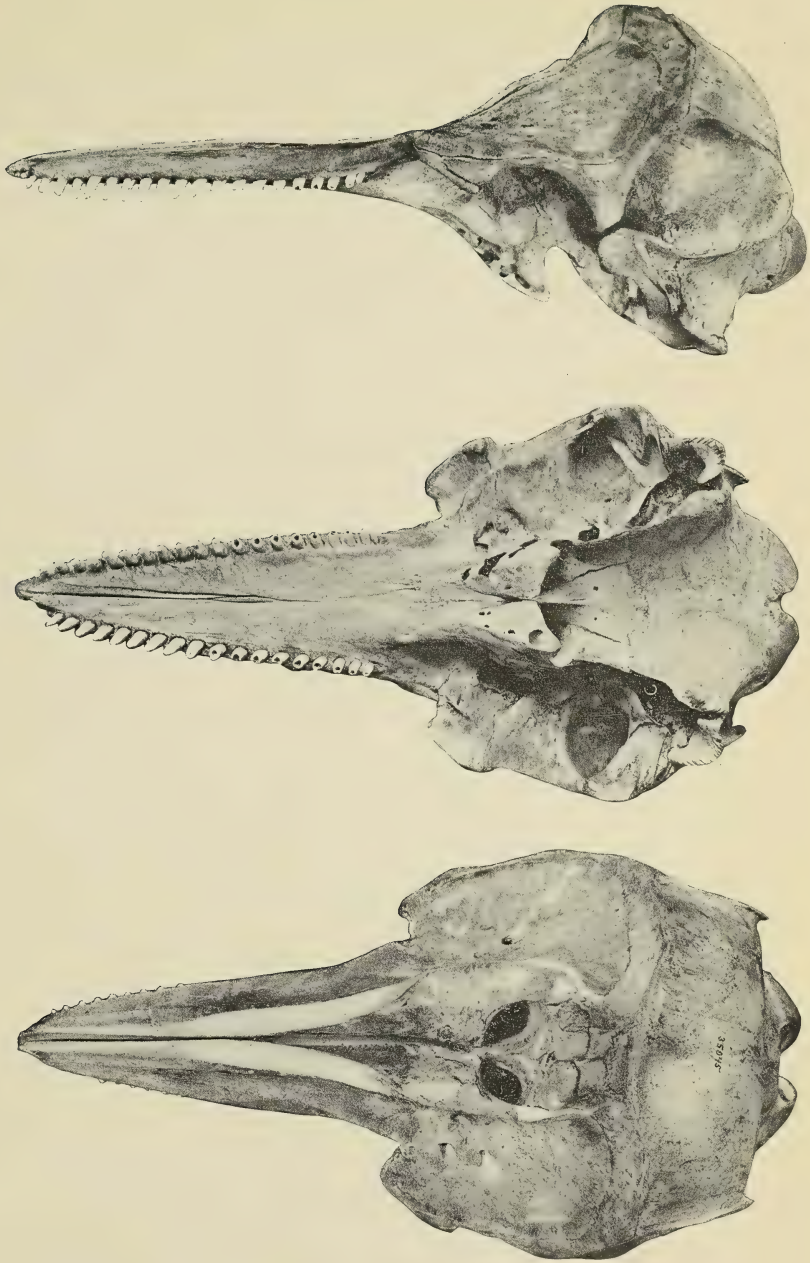
colored ducks, white pelicans, black iridescent adult male cormorants and anhingas, and dull, lustreless black or dark gray young cormorants and female anhingas and coots, and bicolored grebes, and on the edges herons and storks and ibises and spoonbills, blue, white, black, rosy, purple, slatecolor, greenish, grayish, brownish, of all imaginable shades and combinations of hue (once we found the remains of a heron in a crocodile and I have known of them containing the remains of geese, ibis, ducks, coots and flamimgos); and it is a physical impossibility that all these colors can be concealing, unless we accept the view that no color or combination of colors can ever be anything except concealing — which of course makes the whole discussion meaningless.

I have spoken of Mr. Thayer as well-meaning; but it is difficult to admit that certain of his pictures and statements are to be pardoned on the ground that he is merely a well-meaning and ill-balanced enthusiast. Some of them are such striking perversions, and inversions, of the truth that Mr. Thayer seems to have more to account for than bad judgment — very bad though his judgment is. Certainly his experiments, and the pictures by which he illustrates them, can have little real value until he learns to study and portray facts with the sincere intention of finding out the truth, and not with the purpose to exercise a misdirected ingenuity in twisting and distorting the facts so as to back up the many portions of his theory which have no substantial foundation whatever. Nothing is to be gained by such conduct, or by studying the results of such conduct. A "laboratory" carried on in such fashion, and with such experiments, is of worse than no help to the truth-seeker, and serves no better purpose than to amuse and puzzle well-meaning persons who naturally do not think out the matter for themselves. Such a "laboratory" is of no more use than a dime museum, and the "experiments" in it are of very much less use than really good juggling feats.

This is not a case of differences in observing facts, or in forming judgments upon them when observed. Very good men often differ radically in such matters; and the most faithful observers make errors, and under some circumstances make many errors, and draw many wrong conclusions. Even Mr. Selous and Captain Stigand, to whom more than to any other men we owe our knowledge of the natural history of African big game, now and then state facts with which the facts as I have observed them do not seem to agree, or occasionally draw conclusions from which I am inclined cautiously to dissent; and where such experts as these men occasionally make slips, it behooves the rest of us to be exceedingly humble-minded. On this very subject of concealing coloration two such naturalists as Mr. Chapman and Mr. Allen are not in entire accord, Mr. Chapman believing that the coloration of most birds has a larger share in concealing them than has seemed to me probable, while Mr. Allen holds the view that any coloration is protective as long as the animal is motionless, and that "coloration is a minor asset in an animal's protection in comparison with its other qualities — alertness, truculence, and other traits that make for its protection." Such differences among competent men sincerely seeking to find out the exact facts make for truth, and tell in favor of right thinking. The exact proportion of soundness and of error in our various views must largely be determined by further and exhaustive investigations; all that we ask is that these investigations be undertaken by capable and efficient men who desire to find out the truth, whatever it may be, and who are incapable of misrecording or manipulating facts in order to fit them into their own pet theories. For instance, take the question of the light-rump patch so frequent on ruminants, which Mr. Thayer

treats as always concealing. In its extreme form, as on the prongbuck, it is certainly advertising. But in its simplest form it is practically the same on many ruminants and on many carnivores; I have before me at the moment the skins of a topi and a lion, which show it in almost precisely similar fashion; and even Mr. Thayer can hardly suppose that the light-rump patch of a lion is designed to mislead some animal which may spring on him from behind. What is here needed is such wide investigation as will show whether these light patches have any affect at all on the animals' lives and whether they have any effect whatever.

As an example of precisely the kind of investigation needed I may mention Mr. Reighard's 'Experimental Field-study of Warning Coloration in Coral-reef Fishes," published in Vol. II of 'Papers from the Tortugas Laboratory of the Carnegie Institution of Washington.' In this paper Mr. Reighard shows that many coral-reef fishes have a highly advertising coloration, which never has any concealing, but always a revealing quality, this advertising coloration having apparently been developed because their habits and habitat have rendered concealing coloration of no consequence to them, so that their brilliant coloration patterns have developed unhampered by selection, as the result of some tendency, of some internal force or principle having no relation to utility; which is exactly the conclusion I have reached above as regards multitudes of species of birds with widely varying, and often highly advertising, coloration patterns, which dwell by the lakes and rivers, in tree tops or hedges, and in many other localities.



Tursiops nuuanu sp. nov.
Reprinted from Bull. A. M. N. H., Vol. XXIV, Plate XIV.

59.9,53T

Article IX.— DESCRIPTION OF AN APPARENTLY NEW PORPOISE OF THE GENUS *TURSIOPS*, WITH REMARKS UPON A SKULL OF *TURSIOPS GILLII* DALL.

By Roy C. Andrews.

Plate X.

In 1908, Mr. John T. Nichols published in this 'Bulletin' a paper entitled, 'Notes on Two Porpoises captured on a voyage into the Pacific Ocean' [1] in which he discussed a specimen of the genus *Tursiops*, captured in approximately Lat. 12° N., Long. 120° W.

The skull, alone, of this porpoise was preserved and after comparing it carefully with the great series of *Tursiops* in the U. S. National Museum, Mr. Nichols came to the following conclusion: "This animal is quite different from *Tursiops gillii*, and probably different from *T. truncatus* of our Atlantic coast, though the material is not sufficient to warrant separating it positively from that species" (*l. c.*, p. 218).

During the recent expedition of the U. S. S. 'Albatross' to Lower California waters, under the leadership of Dr. Charles H. Townsend, two beach-worn, but fairly perfect, skulls of porpoises were secured on Santa Catalina Island in the Gulf of California, and one skull at San Bartolome Bay on the west coast of Lower California. The first two (Nos. 31830 and 31831) are unquestionably specifically identical with Mr. Nichols's specimen and seem to demonstrate that the species is new.

Mr. Nichols has very kindly asked me to describe the new form, and, at his request, I take pleasure in naming it *Tursiops nuuanu*, after the ship from which he secured the type specimen.

Tursiops nuuanu sp. nov.

Type No. 35045, ad. Approximate locality, Lat. 12° N., Long. 120° W., December 6, 1906.

"Color slaty black, grayer from throat to vent. Approximate length, 7¼ feet" (*l. c.*, p. 217).

Skull.— Temporal fossæ much smaller than in *T. truncatus*. Orbits not so curved, due to a shortening of the posterior, downward-projecting spurs of the orbital processes of the frontals. The maxillary and frontal orbital processes, and the plates

[1] Notes on Two Porpoises captured on a voyage into the Pacific Ocean. By John Treadwell Nichols. Bull. Amer. Mus. Nat. Hist., Vol. XXIV, 1908, Art. XIV, pp. 217–219, pl. xiv. The plate is here reprinted.

of the maxillæ just postero-external to the maxillary notches, are much thinner than in *T. truncatus* or *T. gillii.* The malar along its outer free border is longer and thinner, the vomer visible between the backward prongs of the two pterygoids is wider, and the beak is flatter distally than in *T. truncatus.*

The small size of the temporal fossæ of the three specimens representing *T. nuuanu* is, to my mind, alone strong evidence of its specific distinctness from *T. truncatus.* Because of the small fossæ, and the orbital thinning of the maxillary, frontal and malar bones, the skull presents, in a lateral view, quite a different appearance from that of *T. truncatus* and one which is decidedly striking when skulls of the two species are together.

In regard to the vomer, after examining the great series of *T. truncatus* skulls in the National Museum, Mr. Nichols said: "On the under side of the back of the cranium at the posterior border of the inferior nares, the vomer is visible between the backward prongs of the two pterygoids. At this point its sides are flaring, and it is much broader than either pterygoid alone. There is considerable variation in the series of *truncatus* skulls examined as to the comparative breadth of the vomer, but it is generally narrower than in No. 35045, even to less than half the breadth of a single pterygoid; and its sides are not flaring, *i. e.,* they have a more parallel tendency.....

"There is a *truncatus* skull [1] in the National Museum Collection from off Hatteras, N. C., which has the conditions back of the maxillary notch perhaps more like those of No. 35045 than like those found typically in *truncatus.* In the 'Ostéographie des Cétacés,' Van Beneden and Gervais, there is a figure [2] of a skull of *T. truncatus* from Cette, France, which shows plainly the vomer-pterygoid conditions, and they are very like those of No. 35045" (*l. c.,* pp. 218, 219).

In No. 31831, from Santa Catalina Island, the shape of the vomer is almost identical with the corresponding bone in Mr. Nichols's specimen. In the other Santa Catalina Island skull (No. 31830) the sides of the vomer are somewhat less flaring but still closely approach the condition seen in the type.

The thinning of the orbital processes of the maxillæ and frontals, and the length of the malar, while very striking in the type and in the two Santa Catalina Island specimens, must be considered as characters of doubtful importance since all three bones, in this respect, are subject to much individual variation.

In the following table the ratios of the length of the temporal fossæ to the total length of the skull of six specimens of *T. truncatus,* three of *T. nuuanu* and two of *T. gillii* are given.

---

[1] Nat. Mus. No. 21538. Off Hatteras, N. C. U. S. F. C.

[2] Van Beneden and Gervais, 1868–1879, Ostéographie des Cétacés, pl. xxxiv, fig. 6.

Species.	Collection and Cat. No.	Locality.	Length of skull. mm.	Length of temp. fossa. mm.	%	Depth of temp. fossa. mm.	%
T. truncatus[1]	U. S. Nat. Mus. 12276	Beaufort, N. C.	471	113	*23.9*	73	*15.5*
"	U. S. Nat. Mus. 12274	"	470	112	*23.8*	82	*17.4*
"	U. S. Nat. Mus. 12016	Ft. Macon, N. C.	450	110	*24.4*	79	*17.5*
"	U. S. Nat. Mus. 22081	Hatteras, N. C.	440	107	*24.3*	73	*16.8*
"	U. S. Nat. Mus. 22085	Hatteras, N. C.	413	104	*25.1*	77	*18.6*
"	A. M. N. H. 22989	Pelham Bay, N. Y.	451	110	*24.3*	83	*18.4*
T. nuuanu	A. M. N. H. 35045	Pacific O., 12°N., 120° W.	482	104	*21.5*	73	*15.1*
"	A. M. N. H. 31830	Santa Catalina Is., G. of Cal.	510	104	*20.3*	72	*14.1*
"	A. M. N. H. 31831	"	473	90	*19.0*	78	*16.5*
T. gillii	U. S. Nat. Mus. 12054	Lower Cal.	540	135	*25.0*	85	*15.7*
"	Mus. d'Hist. Nat. a3060	Monterey, Cal.	508	117	*23.0*	74	*14.5*

It will be seen from the foregoing table that in all the skulls of *T. truncatus* the proportional length of the temporal fossa is considerably greater than in *T. nuuanu.* Again the *average* of the relative lengths of the fossæ in the six specimens of *T. truncatus* is 24.3%, while in the three skulls of *T. nuuanu* it is only 20.3%.

The relations of *T. nuuanu* and *T. gillii,* which also occurs along the coast of Lower California, are most interesting because the former species differs from the latter in just the characters which separate *T. gillii* from *T. truncatus.*

In his 'Review of the Delphinidæ' Dr. F. W. True speaks as follows regarding *Tursiops gillii:*[2]

"In *T. tursio* the optic canal rises gradually to the level of the antero-internal border of the frontal, and the whole inferior surface of the frontal is nearly plane. In *T. gillii* the optic canal ends abruptly without reaching

[1] Measurements of U. S. Nat. Mus. specimens kindly furnished by Dr. F. W. True.

[2] A Review of the Family Delphinidæ. By Frederick W. True. Bull. U. S. Nat. Mus. No. 36, 1889, pp. 43, 44.

the level of the prominent rounded antero-internal border of the frontal, which latter bone is deeply concave.

"In the wall of the temporal fossa of *T. gillii* the lower part of the parietal appears as a narrow band between the anterior margin of the squamosal and the posterior margin of a backward extension of the frontal, while in *T. tursio* the frontal has no backward extension and the parietal is broad inferiorly."

The three specimens of *T. nuuanu* have the optic canal and the inferior surface of the frontal exactly as in *T. truncatus.* In the wall of the temporal fossa of *T. nuuanu* the lower part of the parietal is somewhat narrower than in *T. truncatus* but still closely approaches the condition seen in that species, and the frontal is not extended backward as in *T. gillii.*

Dr. True believes the large condyle of the mandible to be an additional distinguishing character of *T. gillii.* The mandibular condyle of the type specimen of *T. nuuanu* is exactly as in *T. truncatus, i. e.* its greatest diameter is contained two and one half times in the greatest depth of the ramus, as against two times in *T. gillii.*

The vomer-pterygoid condition and the small temporal fossa of *T. nuuanu,* characters distinguishing that species from *T. truncatus,* are apparently not of value in separating it from *T. gillii.* In two skulls of *gillii* the vomer is considerably expanded between the backward prongs of the pterygoids and in one (No. 32015 A. M. N. H.) the temporal fossa seems to be relatively small although the rostrum is so badly broken as to make an accurate estimate of the skull's total length very difficult.

Tursiops gillii *Dall.*

Dr. Townsend was fortunate in securing at San Bartolome Bay, on the west coast of Lower California, the skull of a porpoise which seems to be referable to *Tursiops gillii* Dall.

This specimen is of importance since, so far as I am aware, but two other skulls and the type mandible have been thus far recorded; it also apparently shows that two species of *Tursiops* actually do occur upon the Lower California coast.

Through Dr. True's kindness a skull (No. 12054) of *Tursiops gillii* in the U. S. National Museum collection was forwarded to me for examination and comparison with the one secured by Dr. Townsend at San Bartolome Bay.

This specimen (A. M. N. H., No. 32015) has lost the distal portion of the rostrum and is otherwise damaged, but it presents all the characters

given by Dr. True as diagnostic of the species and makes it worth while to note others not mentioned by him.

A striking feature of the San Bartolome Bay specimen is a strong constriction of the palatine bones just opposite the anterior tips of the pterygoids. In the U. S. National Museum skull the narrowing of the palatine region is less pronounced but still fairly well marked. The character does not show in any of the specimens of *T. truncatus* which I have examined nor is it to be found in the three skulls of *T. nuuanu.*

The widening of the posterior portion of the vomer between the backward prongs of the two pterygoids is strongly developed in the San Bartolome Bay skull and less so in the U. S. National Museum specimen. This may be an additional character of value in distinguishing *T. gillii* from *T. truncatus.*

The teeth of *T. gillii* are very heavy and the beak is somewhat flatter than in *T. truncatus* due to a depression of the intermaxillæ.

The mandible of the San Bartolome Bay skull was not secured, consequently it is impossible to say as to whether or not it has the large condyles of the other specimens of *T. gillii.* The condyles of both *skulls* of *T. gillii* now before me are striking in their large size when compared with either *T. truncatus* or *T. nuuanu.*

Measurements of the Skulls of *Tursiops nuuanu.*	No. 35045 Pacific Ocean, 12° N., 120° W.	No. 31830 Santa Catalina Is., Gulf of Cal.	No. 31831 Santa Catalina Is., Gulf of Cal.
	mm.	mm.	mm.
Total length	482	510	473
Length of beak	267	281	256
Breadth of beak at base of notches	117	135	126
" " " " its middle	74	80	77
" of intermaxillæ at middle of beak	40	42	45
Greatest breadth between outer margin of intermx. proximally	85	95	86
Tip of beak to anterior margin of superior nares	321	325	310
Breadth of skull (orbital)	218	221	—
" between posterior margins of temporal fossæ	156	—	159
Length of temporal fossa	104	104	90
Depth " " "	73	72	78
Length of mandible	408	—	—
" " symphysis of mandible	54	—	—
Depth between angle and coronoid	86	—	—
Number of teeth (maxilla)	22	—	—

Article X.— MAMMALS FROM VENEZUELA COLLECTED BY MR. M. A. CARRIKER, JR., 1909–1911.

By J. A. Allen.

In July, 1909, Mr. Carriker left New York for South America, to be absent for several years on a collecting trip for birds and mammals, jointly for the Carnegie Museum of Pittsburgh and the American Museum of Natural History of New York; all of the birds were to go to the former and all of the mammals to the latter of these two institutions. Much more attention, however, appears to have been given to birds than to mammals, the latter thus far received numbering only about 450 specimens. Of these about 50 were collected in the Island of Trinidad and the remainder in Venezuela. Only those obtained in Venezuela are here recorded, and number 66 species.

Mr. Carriker's work in Venezuela was carried on in two quite different regions — (1) in the Rio Caura basin and eastward, September, 1909, to June, 1910; (2) in the northern coast region inland from Puerto Cabello, September, 1910, to March, 1911.

The principal localities at which mammals were obtained are the following:

Southern district. Maripa, Rio Caura; Rio Mato and Rio Mocho, tributaries of the Rio Cauca; Rio Yuruan and Rio Cuyuni.

Northern district. Valley of the Rio San Esteban and the mountain ranges to the southwestward. Principal localities: San Estaban, altitude 250 feet; El Hacha, 460 feet; Las Quiguas, 650 feet; Aroa, or Pueblo Nuevo, 730 feet; Lagunita de Aroa, 1820 feet; Tocuyo, 2190 feet, Guarico, 3602 feet; Anzoatequi, 4705 feet; Paramo de Rosas, 10,817 feet (at the crest where the trail crosses the paramo).

Mr. Carriker states, in connection with his notes on the mammals: "The San Esteban valley opens upon the sea near Puerto Cabello, and extends southeastward, flanked on either side by high ridges, and rising rapidly in its upper part to the crest of the coast range. The pass at its head has an altitude of 4443 feet, while the range rises on either side to about 6000 feet at the highest points. The vegetation at the lower end of the valley is a low, dense, scrubby growth with many cacti, which is gradually replaced higher up, as in the vicinity of San Esteban, by heavy forest. San Esteban is 5 miles from Puerto Cabello, at an altitude of about 250 feet. Above San Esteban the valley becomes narrower and rises more

rapidly. Las Quiguas is about 4 or 5 miles above San Esteban, with an altitude of 650 feet. At this point it is very humid, the virgin forest dense and damp. A trail leads up the valley and over the pass (La Cumbre de Valencia, altitude 5000 feet) to Valencia. The south side of the coast range is entirely different from the north side, which faces the sea. While the north slope is very humid and heavily forested, the south slope is all open savanna, from the crest downward."

From Mr. Carriker's "Descriptions of localities in western Venezuela at which Collections were made between November 20 and March 24, 1910 and 1911," received after the manuscript of this paper was sent to the printer, the following extracts are taken, which give welcome information respecting the general character of the districts he visited.

"*El Hacha* (altitude, 469 feet). El Hacha is a small station on the Bolivar Railway, 75 kilometers from Tucacas (on the coast) and 85 kilometers from Barquisimeto. It lies in the upper end of a wide, level valley drained by the Aroa River, the whole valley being covered with forest, mostly of a low tangled nature, which makes collecting very difficult, in fact impossible except in the more open parts of the forest or along the line of the railway. The rainfall is heavy, with no regular seasons, the precipitation being pretty evenly distributed throughout the year. The railway at this point runs along the east or rather the southern side of the valley and only about six miles from the foothills of a considerable range of mountains. This range of mountains extends northeastward from the central plateau nearly to the north coast, and attains an altitude of about 5000 feet at a point between [Aroa or] Pueblo Nuevo and Guama. The range is narrow, being not more than 15 miles in width at its highest part, and densely forested over the whole of the northwestern slopes and summit, but having extensive savannas on the lower slopes of the southeast side. With a few exceptions the bird fauna appears to be the same as that of the northern coast range, which extends from a point a little west of Puerto Cabello to the tip of the Paria Peninsula opposite Trinidad. I was not able to work in the higher portions of the range as it is absolutely uninhabited. The highest point reached was near Lagunita, on the west side, where some work was done on a ridge having an average altitude of 3200 feet. At this point I found most species to be the same as those taken on the Cumbre de Valencia.

"From El Hacha there extends a branch line of the railway to Pueblo Nuevo (or Aroa as it is called on the maps), a distance of six miles, which village lies just at the edge of the foothills. In working upward toward Pueblo Nuevo from El Hacha a change is at once noticed in the bird fauna; many species, found abundantly in the low, central part of the valley,

become scarce or disappear, while others more addicted to the hills begin to put in their appearance ....

"*Pueblo Nuevo* (altitude, 730 feet). Aroa is the name now used to designate the district of which Pueblo Nuevo is the center, but it was formerly applied to the copper mine situated about three miles up the gorge of the Aroa River. It is the headquarters of the Bolivar Railway. The whole surrounding country is, or was, forested, but there are now large tracts of 'rastojo' and considerable cultivated land, for it has been settled a long time on account of the copper mine which was discovered and operated by the Spaniards for many years. I found very little of interest there in the way of birds, while collecting was difficult and birds scarce....

"*Lagunita de Aroa* (altitude, 1820 feet). This is the name of a small district up in the hills above Pueblo Nuevo on the road from that point to Guama. It consists of a few scattered houses and small coffee plantations owned for the greater part by poor people. At Lagunita most of the work was done between 1800 and 3000 feet, only a few birds being taken on the slopes below. The forest is dense here and fairly easy to penetrate, but the country very broken and the slopes precipitous....

"*Tocuyo* (altitude, 2190 feet). Tocuyo is about fifty miles from Barquisimeto in a southwesterly direction and lies at the extreme southwestern end of the central plateau region of Venezeula.... There extends from Barquisimeto to Tocuyo a level, arid, cactus-covered plain, surrounded on all sides by mountains of varying height, but all absolutely barren and devoid of vegetation with the exception of the cacti and allied plants. To the west the mountains separate the plain from the lowlands along Lake Maracaibo, while to the east or southeast, they separate it from the great 'llanos' of the Rio Apure. On the southeastern side there are two parallel ranges of mountains, those next the plain being low and arid while the outside range is much higher, with the lower slopes, fronting the plain, consisting of savannas and the summits and outer slopes heavily wooded. It is in this higher wooded range that the numerous large tributaries of the Apure have their source. The plain at Barquisimeto has an altitude of 2000 feet, rising gradually to a point just beyond Quibor where nearly 3000 feet is reached, then dropping down to the valley of the Rio Tocuyo. The highest point in the eastern range is just about south of Quibor above Sanare, where I should judge the highest point to be nearly 8000 feet (highest point measured was at Guarice, 6000 feet, where it must be at least 1500 feet lower than at Sanare).

"All around Tocuyo is found the same arid condition, but not so intense as at Barquisimeto and Quibor, owing I suppose to the presence of the Tocuyo River and the large areas under irrigation along its banks. No

woodland is to be found there, only cacti and low thorny trees along the bottoms of the dry ravines running down from the hills.... Opposite Tocuyo, to the southwest rises a bold precipitous range of barren mountains, the terminus of the Venezuelan Andes, which extends in an unbroken chain south and southwest to the Sierra Nevada de Merida. The Sanare range is separated from the main Andean range by the deep valley through which flows the Rio Portugesa (here very small). Opposite this cleft in the range rise two peaks, closely joined, to an altitude of nearly 9000 feet (which I have called Twin Peak Mountain in my notes), from which extends southward a low ridge of mountains around the head of the Rio Tocuyo and joins the main Andean range about twenty miles south of the Paramo de Rosas.

"Tocuyo and the immediate vicinity is very hot — a dry, desert heat — with almost no breeze, since the whole valley is completely surrounded by high mountains, except the narrow gorge through which the Tocuyo River escapes....

"*Guarico* (altitude, 3602 feet). Guarico lies about eighteen miles from Tocuyo, a little east of south, and at the foot of the main Sanare range, or rather in the valley between the inner arid foothills and the outer main range. It is a pretty little village of perhaps a thousand inhabitants and the center of a rich coffee district. I did no work in the valley around the village, for little was to be found there outside of the species taken at Tocuyo. Instead I moved up the mountain side to the hacienda of Dr. J. A. Perez Limardo (altitude, 4400 feet), and worked from there up to the crest of the Sanare range, which at this point reaches just 6000 feet. The lower slopes (below 5000 feet) are mostly sabana, while the whole crest and southeast slope is densely forested. Some collecting was done in the thickets and wooded ravines of the lower slopes, but most of the work was confined to the forest above.... The forest is very heavy, but not choked up with undergrowth to any extent. The clouds (the higher flying storm clouds) strike the range at about 5600 feet, and above that the forest is a mass of green moss, every trunk, branch and twig being covered with it. Palms are very abundant, and other trees not found lower down.... The whole mountain, down to near the village was almost constantly enshrouded in fog and mist, with a temperature of from 54° to 60° F.

"*Anzoategui* (altitude, 4705 feet). This little village lies almost due west of Guarico, a distance of perhaps fifteen miles (by the road, but much less as the crow flies). It is at the foot of Twin Peak Mountain (north side), and in the head of the valley in which rises the Rio Portugesa. Just below the village, and occupying practically the whole of the valley at that point, is an immense marsh (altitude, 4447 feet), through the center of

which winds lazily the Rio Portugesa, here but a creek. The marsh is known as Sabana Grande, and is about one and a half miles broad by three miles long. The hills rise rather steeply on both sides, coming together near the lower end and forming a narrow deep valley, with broken precipitous sides. Above the marsh the valley is broken and narrows rapidly as it ascends. It is covered with bits of sabana and low scrub, almost no agriculture being attempted. To the north of the valley (between it and the Tocuyo valley) rises a bold, rough range of hills, quite barren, while at the south are the steep slopes of Twin Peaks, thickly strewn with boulders and supporting only grass. The western side of the mountain is without forest up to nearly 8000 feet, but the summit and a deep valley running down the northeast slope are heavily forested. This forest extends down to 5500 feet in the valley. Collecting was done over the whole of the valley and up the mountain as high as 8000 feet, but not much above 7000 feet, for at that point the vegetation becomes so tangled and overgrown with moss that it is quite impossible to penetrate it to any purpose. Roads or trails are non-existent above 6000 feet, while birds are very scarce also. . . .

"*Paramo de Rosas* (altitude of crest where the trail crosses the paramo, 10,817 feet). To reach the Paramo from Anzoategui, the trail follows up the valley in a southwesterly direction, curving around Twin Peak Mountain, and crossing over a shoulder of that mountain at an altitude of 6729 feet, then dropping abruptly down into the upper Tocuyo valley to Humecaro Alto (altitude, 3430 feet). From this village it ascends steeply up the main Andean range in a westerly direction until 5350 feet is reached, after which it follows along the side of a gorge-like valley, up and down, in and out, higher and higher, until a little hamlet called Buenos Aires is reached (altitude, 6500 feet). Here it leaves the stream and climbs abruptly up toward the crest of the range in a southwesterly direction, attaining an altitude of nearly 11,000 feet where it crosses the crest. The whole of the lower slopes of the range below Buenos Aires are covered with a low thick scrub, with patches of sabana here and there, and a little fairly heavy woodland, but no real forest. But from Buenos Aires upward extends a fairly level slope, of from one half to a mile or more in width. This flat was originally densely forested, but it has all been cut away below about 7700 feet. The steeply rising ridges on both sides and the greater part of the backbone of the range is still in forest everywhere above 7000 feet, although there are many barren hog-back ridges, including the whole of the main crest in the part where the trail crosses it and for some distance to the south. I stopped first for a week at an altitude of 6800 feet, collecting between 6500 and 7500 feet, but mostly at about 7000 or 7500 feet. This region is mostly in pasture and tobacco fields or old rastrojo, although

I got up into the virgin forest several times during the week. Later I went up to 8400 feet, working from there both below and above, but I never went below about 8000 feet. At this point the forest extends up the mountain side to the foot of the Paramo, or to an altitude of 9000 feet, above that it is all open country, the ground thickly covered with vegetation like heather or gorse, with grass and low bushes in some places. For the first ten days I had splendid dry, clear weather, but after that there was much rain and mist. I had but one clear day on the Paramo, and during the last week the whole mountain down to about 7000 feet was enshrouded in fog and mist, rendering it impossible to penetrate into the virgin forest.... This is a magnificent field and should be thoroughly worked; in fact, this whole district proved to be surprisingly rich in species, while practically everything on the Paramo range is distinct from the closely adjoining Sanare range."

As would be expected, the mammal fauna of northwestern Venezuela is very different from that of the Caura region and elsewhere in eastern Venezuela south of the Orinoco. As shown by the subjoined lists, only a small proportion of the species are common to the two regions, these being indicated by an asterisk. On the other hand, many species found in the coast mountains of northern Venezuela occur also in the Sierra de Merida, and probably have a nearly continuous distribution through the intervening mountainous district.

Southern District.

Metachirus opossum opossum (*Linné*).
Didelphis marsupialis marsupialis *Linné*.
Bradypus tridactylus flaccidus (*Gray*).
* Tamandua longicaudata (*Wagner*).
Mazama rufa (*F. Cuvier*).
Dasyprocta lucifer *Thomas*.
Cavia porcellus venezuelæ subsp. nov.
Proechimys cherriei (*Thomas*).
Oryzomys (Oligoryzomys) messorius *Thomas*.
Rhipidomys nitela *Thomas*.
Sciurus flammifer *Thomas*.
Sciurus (Guerlinguetus) æstuans gilvigularis (*Wagner*).
Pteronura brasiliensis (*Zimmermann*).
* Tayra barbara barbara (*Linné*).
Nasua phæocephala *Allen*.
Canis (Carcinocyon) thous *Linné*.
* Rhynchiscus naso (*Wied*).
Saccopteryx bilineata (*Temminck*).
" leptura (*Schreber*).
* Peropteryx kappleri *Peters*.
Chilonycteris rubiginosa rubiginosa *Wagner*
* Micronycteris megalotis *Gray*.
Chrotopterus carrikeri *Allen*.
Glossophaga soricina (*Pallas*).
* Hemiderma perspicillatum (*Linné*).
Eptesicus hilarii (*Geoffroy*).
Promops milleri *Allen*.
Molossus obscurus (*Geoffroy*).
* Alouatta macconnelli *Elliot*.
Ateles variegatus (*Humboldt*).
* Cebus apiculatus *Elliot*.

Northern District.

Marmosa fuscata *Thomas.*
Marmosa mitis costa *Thomas.*
Philander regina (*Thomas*).
* Tamandua longicaudata (*Wagner*).
Tayassu torvum *Bangs.*
Sylvilagus cumanicus (*Thomas*).
Agouti sierræ *Thomas.*
Agouti paca (*Linné*).
Dasyprocta rubrata *Thomas.*
Proechimys gueræ *Thomas.*
Loncheres carrikeri sp. nov.
Heteromys anomalus (*Thompson*).
Oryzomys meridensis *Thomas.*
" modestus *Allen.*
Oryzomys (Oligoryzomys) tenuipes *Allen.*
Oryzomys (Melanomys) venezuelensis (*Allen*).
Sciurus griseogena *Gray.*
Putorius affinis (*Gray*).
* Tayra barbara barbara (*Linné*).
Conepatus marpurito (*Gmelin*).
Urocyon cineroargentea venezuelæ subsp. nov.
Felis pardalis (subsp. incog.) *Linné.*
* Rhynchiscus naso (*Wied*).
* Peropteryx kappleri *Peters.*
" canina (*Wied*).
Chilonycteris rubiginosa fusca subsp. nov.
Chilonycteris personata *Wagner.*
Pteronotus suapurensis *Allen.*
* Micronycteris megalotis *Gray.*
Lonchorina aurita *Tomes.*
Mimon bennettii *Gray.*
Phyllostomus hastatus (*Pallas*).
Trachops cirrhosus (*Spix*).
Glossophaga longirostris *Miller.*
* Hemiderma perspicillatum (*Linné*).
Sturnira lilium (*Geoffroy*).
Uroderma bilobatum *Peters.*
Artibeus cinereus (*Gervais*).
Desmodus rotundus (*Geoffroy*).
Phodotes tumidirostris continentis *Thomas.*
* Alouatta macconnelli *Elliot.*
* Cebus apiculatus *Elliot.*

Although the number of species represented in the collection is small relatively to the number probably occurring in the districts visited, they add not only many new forms to our collection of mammals but throw much light on the ranges of the species collected. Only five forms proved to be undescribed. Mr. Carriker's field notes on most of the species are a feature of interest. These are given in marks of quotation, followed by the initials, "M. A. C."

In a former paper (this Bulletin, XXVIII, 1910, pp. 145–149) a list of 14 species collected by Mr. Carriker in the Caura district in 1909 has already been published. These species are here included, with further records of additional specimens of most of them, and the field notes since kindly furnished by the collector.

All the external measurements here given were made by the collector from the animals while in the flesh. All measurements are in millimeters.

I am indebted to Mr. Gerritt S. Miller, Jr., Curator of Mammals, U. S. National Museum, and to Mr. Outram Bangs, Curator of Mammals, Museum of Comparative Zoölogy, for the use of specimens kindly loaned for examination in the present connection.

Didelphiidæ.

1. **Marmosa fuscata** *Thomas.*

One specimen, adult female, La Cumbre de Valencia (altitude 5000 feet), Oct. 20.

"Caught in a trap set for rats in half-rotted limbs and rubbish in heavy forest on the side of a mountain at an altitude of 5000 feet."—M. A. C.

2. **Marmosa mitis casta** *Thomas.*

Two specimens: San Esteban, 1 specimen, adult male (topotype), Nov. 14; Anzoategui, Estada Lara, 1 young male, March 1.

"Caught by a boy, among some banana stalks, on a hillside near San Esteban."—M. A. C.

3. **Philander regina** (*Thomas*).

One specimen, adult female, San Esteban, Nov. 15. Length, 501; tail, 305, hind foot, 33.

"Caught in a field of bananas and plantains near San Esteban."—M. A. C.

In 1900 (this Bulletin, XIII, p. 189) I suggested *Caluromys*, with *Didelphis philander* Linné as type, to replace *Philander* Brisson (1762), on the ground that *Philander* was a pure synonym of *Didelphis* Linné (1758), in as much as each was proposed originally to include all, and only, the marsupials,[1] although each of course included several modern genera. Under the rule of tautonymy, and recent rulings of the International Zoölogical Commission (see especially Opinions 9, 10, and 16), both names are available, and the genotype of *Philander* is *Didelphis philander* Linné by the rule of tautonymy. The designated genotype of *Caluromys* being the same species, *Caluromys* is a synonym of *Philander*.

4. **Metachirus opossum opossum** (*Linné*).

Ten specimens, 1 adult male, 5 adult females, and four young, Rio Yuruan, March 26 and 29, and April 6.

5 old females, length, 512.6 (503–533); tail, 274.7 (265–289); hind foot, 36.4 (35–38); total length of skull, 61 (59–62); zygomatic breadth, 31 (30–32).

1 old male, length, 543; tail, 286; hind foot, 40; total length of skull, 63; zygomatic breadth, 35.

---

[1] *Cf.* Merriam, Science, N. S., I, No. 14, p. 375, April 5, 1895; Allen, Bull. Amer. Mus. Nat. Hist., XIII, pp. 188, 189, Oct. 12, 1900.

"These were trapped both in the forest adjoining the clearing and in the gardens, where they came to eat anything palatable that could be found. They seemed to like ripe bananas as well as meat. The female with a litter of young was taken out of a hollow stump in a grass field in the clearing."— M. A. C.

These specimens are referred to the type form of the group, and Surinam is assumed as the type locality of *Didelphis opossum* Linné (*cf.* Allen, this Bulletin, XIII, 1900, p. 195). They differ from specimens from western Colombia, Central America, and Mexico in much smaller size. They agree in color very closely with the Mexican form (*pallidus*), from which they are separated geographically by the dark forms of Colombia and Central America.

The forms of this group at present recognized are the following:

1. *Metachirus opossum opossum* (Linné). Type locality, by subsequent designation (Allen, 1900), Surinam.
2. *Metachirus opossum fuscogriseus* Allen (1900). Type locality, Greytown, Nicaragua.[1]
3. *Metachirus opossum pallidus* Allen (July 3, 1901). Type locality, Orizaba, Vera Cruz, Mexico.
4. *Metachirus opossum melanurus* Thomas (Oct., 1899). Type locality, Paramba, Rio Mira, northern Ecuador.

5. **Didelphis marsupialis marsupialis** *Linné.*

One specimen, adult female, Peru Mine, El Callao, May 11. Length, 798; tail, 410; hind foot, 55.

"This beast is common everywhere and a nusiance to the trapper, either by eating the bait and getting caught in the larger traps or by robbing the small traps of rodents already caught. I have caught it repeatedly from the Orinoco to the mountains back of Puerto Cabello up to 4000 feet." — M. A. C.

Bradypodidæ.

6. **Bradypus tridactylus flaccidus** (*Gray*).

Rio Mato (this Bull., XXVIII, p. 145).

La Bomba, April 21, one specimen.

"This sloth was taken in a most unusual place, being found in a low shrub out in the savanna about 50 yards from a patch of low, tangled wood-

[1] The locality of the type is not certainly known but was presumed to be Colon, Panama, or "Central America" (*cf.* Allen, this Bulletin, XIII, 1900, p. 195). During the last ten years a large number of specimens, collected in Panama, Costa Rica and Nicaragua, have passed through my hands. As the second account of the subspecies (this Bulletin, XIII, 1901, p. 213) was based on specimens from the lower Bluefields River, the type locality may be established as Greytown, Nicaragua.

land. They are exceedingly hardy beasts and very tenacious of life. To kill them outright seems almost impossible, for even when shot through the brain or even *heart,* they still give evidence of life for some minutes, and if hanging, will not fall for some time. In fact they, like *Mycetes* and *Ateles,* will often cling after death until the passing of rigor mortis releases the contracted limbs.

"It has a doleful, yet not unpleasant crooning or 'cooing' cry which it utters as a rule about sunset for several minutes at a time." — M. A. C.

Myrmecophagidæ.

7. **Tamandua longicaudata** (*Wagner*).

Maripa (Bull., XXVIII, p. 146).

El Hacha, Bolivar Railroad, one specimen, adult female, Nov. 28. Length, 940; tail, 470; hind foot, 84.

"This species seems more fond of the low tangled woodland bordering the savannas than the heavy forest. They are largely nocturnal, terrestrial, and very stupid. I met one beside a path digging, in the early morning, which was easily dispatched." — M. A. C.

Tayassidæ.

8. **Tayassu torvum** *Bangs.*

One specimen, young female, Lagunita de Aroa, Dec. 20. Part of milk dentition still in situ.

"The peccary was not found to be common anywhere in western Venezuela, but is presumably common in some districts." — M. C. A.

Cervidæ.

9. **Mazama rufa** (*F. Cuvier*).

One specimen, adult female, Rio Yuruan, March 21. Length, 2057; tail, 152; skull, greatest length, 228; zygomatic breadth, 100; length of upper toothrow, 62.

"This deer was common in the heavy forest of the Rio Cuyuni, and differs considerably in color from the savanna species. They frequent the impenetrable jungles and wild cane patches, and are, needless to say, very difficult to shoot. The best way is still hunting early in the morning or late in the evening." — M. A. C.

LEPORIDÆ.

10. **Sylvilagus cumanicus** (*Thomas*).

Five specimens, 2 adult males, 2 adult females, and a two-thirds grown male, Tocuyo, Jan. 23–26.

2 males,	length 405, 410;	tail, 44, 50;	hind foot, 80, 81.
1 female,	" 410	" 40	" 85.

This species is very distinct from *Sylvilagus superciliaris* from the Santa Marta district of northeastern Colombia and from *Sylvilagus meridensis* from Merida, Venezuela, with topotypes of both of which it has been compared.

AGOUTIDÆ.

11. **Agouti sierræ** *Thomas.*

One specimen, male, Paramo de Rosas, March 22, 1911. Length, 565; tail, 21; hind foot, 98.

Agrees satisfactorily with the description of *A. sierræ* from Sierra de Merida, Venezuela. The pelage is very long and full, and the color very dark.

"The capabara taken at the Paramo de Rosas was caught under a great boulder on the mountainside at an altitude of about 8000 feet. It seemed to me to be different in some respects from the lowland specimens which I have seen." — M. A. C.

12. **Agouti paca** (*Linné*).

One specimen, female, El Hacha, Jan. 7. Length, 560; tail, 27; hind foot, 97.

"The agouti is very widely distributed, being found in *all* woodland (but preferring heavy forest) from sea level up to considerable elevations (I saw one at 5000 feet on the Cumbre de Valencia). It is largely nocturnal, living by day in hollow logs and under old roots. However, it is not uncommonly found at large during the day, especially early in the morning or at sunset, when they are fond of emerging from the forest to feed in fields and gardens. They are very shy and difficult to shoot, and harder to trap." — M. A. C. [These notes evidently refer in part to *A. sierræ*, especially the reference to the Cumbre de Valencia.— J. A. A.]

13. **Dasyprocta lucifer** *Thomas.*

One specimen, adult female, Rio Yuruan, April 14.

14. **Dasyprocta rubrata** *Thomas.*

Three specimens, an adult male, a young male and a young female, both of the latter in first pelage: San Esteban (adult), Nov. 5; Anzoategui, Estada Lara (2 young), Feb. 2. The adult male is not distinguishable from typical specimens of *D. rubrata* from Trinidad, the type locality of the species.

A series of 5 specimens from Trinidad indicates a wide range of what seems to be individual variation in color. Two of them agree strictly with the original description of *rubrata* (Thomas, Ann. and Mag. Nat. Hist. (7), II, Sept. 1898, p. 273); a third specimen is superficially like the two just mentioned, but the dorsal area is somewhat darker, and the hairs more narrowly ringed with rufous, the annulations extending uniformly to the base of the hairs without any basal area of orange or chestnut over the posterior back and rump, as in the type specimen of *rubrata* and the two mentioned above. These three specimens are all from the lowlands near Princestown. Two others from the interior of the island, at somewhat higher elevation, are both much darker than the other three. One of these is only a little darker than No. 3 just described, but the blackish tint is more predominant, the rufous annulations narrower and extending to the base of the hairs, including those of the lower back and rump. The other specimen is still darker, the general color being blackish, slightly relieved by narrow rufous annulations, confined posteriorly to the apical portions of the hairs, the remaining portion being blackish. The skulls show that these differences are not due to age, nor do they suggest either specific or subspecific differentiation. In coloration the 5 specimens show intergradation from the two like the type of *rubrata* to the very dark one last described.

The two young specimens (length only 250 mm.) from Anzoategui, both taken on the same date and probably from the same litter, may be fairly termed dichromatic, one having the lower back and rump dark rufescent, while the same parts in the other are entirely black.

"Fairly abundant in the San Esteban valley from a point where the heavy forest begins up to at least 5000 feet. It is very shy and hard to shoot." — M. A. C.

Caviidæ.

15. **Cavia porcellus venezuelæ** subsp. nov.

Type, No. 30742, ♂ ad., Altagracia, Immataca district, Venezuela, June 9, 1910; coll. M. A. Carriker, Jr.

Similar in size and general appearance to *C. p. guianæ* Thomas from the Kanuku Mountains, southwestern British Guiana, but differing in details of coloration.

General color above gray, strongly varied with black, the hairs annulated near the tip with fulvous; darkest on the head and middle of the back posteriorly, lighter and more fulvous over the shoulders; underparts white with a slight grayish cast, the hairs not very appreciably darker basally; a broad band of gray across the foreneck; feet gray with a slight tinge of fulvous, not "lightening to nearly white on the fingers and toes" as in *C. p. guianæ*; no light eyering, and ears blackish, not whitish as in *C. p. guianæ*; nose light gray or whitish.

Total length (head and body), 265; hind foot, c. u. 46. Skull, greatest length, 60; basilar length, 47; greatest breadth, 32.5; nasals, 20 × 8; diastema, 16.5; length of molar series (alveoli), 14.

Represented by the type only, an adult but not old male, taken in the Immataca district of eastern Venezuela, very near the British Guiana boundary. This is apparently the first record of the genus *Cavia* for Venezuela.

"Caught in an old outbuilding amongst some rubbish." — M. A. C. [When first seen it was mistaken by the collector for a young agouti.]

Octodontidæ.

16. **Proechimys cherriei** (*Thomas*).

Rio Mocho (Bull., XXVIII, p. 146).

Six specimens, Rio Yuruan, March 24–April 6. Two have only the basal two inches of the tail, the rest evidently having been shed during life.

"The spiny rats were trapped in the little garden patches of the laborers, to which they came from the forest to feed. It is curious how many of these without tails were caught." — M. A. C.

17. **Proechimys guiræ** *Thomas.*

Eleven specimens: Las Quiguas, 1, Sept. 14; San Esteban, 6, Oct. 28–31, Nov. 7 and 9, and Dec. 28; Laganita de Aroa, 4, Dec. 22–30.

"I caught only one of these rats at Las Quiguas; it was apparently more abundant about San Esteban. I caught them among the rocky cliffs along the river as well as in old second-growth." — M. A. C.

18. **Loncheres carrikeri** sp. nov.

Type, No. 31530, ♀ ad., San Esteban, Venezuela, Nov. 15, 1910; coll. M. A. Carriker, Jr. (orig. No. 8633), for whom the species is named.

Similar in size to *Loncheres punctatus* Thomas, from Caicara, Venezuela, but much darker, and with important cranial differences.

Head and sides gray; mid-dorsal region blackish mixed with rufous, the long stiff hairs and bristles being black-tipped, the coarser spines black with conspicuous

white tips, most abundant on the posterior half of the back, while the finer under hair is rufous showing at the surface between the bristles and spines; ventral surface gray washed with white, with a fairly distinct gray pectoral band; feet, outer surface of limbs and ventral surface of base of tail gray; ears brownish black; tail brown, well covered with short stiff hairs, through which, however, the annulations are clearly seen.

Total length, 467; head and body, 224; tail, 243; hind foot, 40. Skull, total length, 52; basal length, 46; zygomatic breadth, 26. The skull is narrow and slender, the rostral portion very narrow and somewhat tapering, the anterior nares much narrower than in *L. punctatus*.

Represented only by the type, a very old female with the sutures of the skull almost wholly obliterated. In external measurements it agrees with topotypes of *L. punctatus*, collected at Caicara by George K. Cherrie (measurements by Mr. Cherrie), but the skull is much smaller and slighter than in *L. punctatus* and the dentition is correspondingly lighter, but the teeth are similar in details of structure. In comparison with *L. punctatus* the posterior nares are much narrower and shallower, the basioccipital, relatively as well as actually, much shorter and narrower, and the more swollen bullæ are shortened in correlation with the shortened basioccipital region. The bullæ are nearly as broad as long, and are thus nearly spherical instead of elongate as in *L. punctatus*. The two species are thus not only strikingly different in coloration but also in important details of cranial structure.

" I shot this rat in the lower branches of a large tree by the road side near San Esteban. I had shot a bird in the same tree, and it seems the shot disturbed the rat from the trunk, from where it ran out on a long limb. It must be rare here, as none of the natives who saw it had ever seen one before." — M. A. C.

19. **Heteromys anomalus** (*Thompson*).

Two specimens, Las Quiguas, Sept. 6. Distinctly referable to *H. anomalus* rather than to *H. jesupi* of the Santa Marta region, Colombia.

"Trapped in a small clearing planted in corn, yucca, etc. Apparently less common than the spiny rats [*Proechimys guiræ*]." — M. A. C.

Muridæ.

20. **Oryzomys meridensis** *Thomas*.

Three specimens, all young adults, La Cumbre de Valencia (altitude 5000 feet), Oct. 19 and 20.

These specimens are doubtfully referred to *O. meridensis.* The older of the three is nearly adult, but the sides of the body are nearer fulvous than rufous, and there is no pectoral white spot in which the fur is white to the base. The other two, somewhat younger, have a small sharply defined V-shaped patch of white on the breast with the fur white to the base. These two specimens are indistinguishable from a Merida specimen of corresponding age identified by me some years since as a topotype of *O. meridensis.*

"Caught in forest at an altitude of about 5000 feet. They were living in the trunk of a fallen tree in a very damp spot."—M. A. C.

21. **Oryzomys modestus** *Allen.*

One specimen, San Esteban, Nov. 9.

This specimen is in bad condition, the ears and tail having been mutilated by ants, and the skull lacks the occipital portion. It agrees so well, however, in size, coloration and in cranial characters with the unique type of *O. modestus* from Campo Allegre, Cumana district, Venezuela, that it is confidently referred to this species.

22. **Oryzomys (Oligoryzomys) tenuipes** *Allen.*

Ten specimens, of which 8 are adult and two are young in the gray first pelage, La Cumbra de Valencia (elevation 5000 feet), Oct. 16–20.

"Abundant in cultivated and in old abandoned fields. Lives in fallen tree-trunks and under stumps."—M. A. C.

These specimens are clearly referable to *O. tenuipes* (this Bulletin, XX, 1904, p. 328) from the mountains near Merida (elevation 1630 meters). The present material shows that the least characteristic of the three original specimens was selected as the type, a young adult not quite in mature pelage, with the rufous of the upperparts not fully developed, and the buff on the underparts rather paler than in average specimens, or than in the paratypes. In adult specimens the upper parts are strongly rufous, faintly varied with black-tipped hairs, and the ventral surface varies in different specimens from cream buff to deep buff. Young specimens in first pelage are dark brownish gray above and mouse gray below, resembling closely in coloration an average young adult common house mouse.

It may be added here that *Oryzomys delicatus* Allen & Chapman, from Capara, Trinidad, is a typical member of the *Oligoryzomys* group, and is, as would be expected, closely related to *O. delicatus.*

The eight adult specimens (4 males and 4 females) measured in the flesh as follows: Total length, 181 (173–191); head and body, 81.6 (76–85); tail, 99.5 (93–103); hind foot, 21.4 (21–22).

The three original Merida specimens measured in the flesh: Total length, 183 (180–190); head and body, 80 (80–80); tail, 103 (100–110); ear, 21 (20–22).

23. **Oryzomys (Oligoryzomys) messorius** *Thomas.*

One specimen, Rio Yuruan, April 1. A young male with m_3 not fully exposed. Upperparts rufous, the plumbeous basal fur imparting a slight grayish cast; underparts white, the basal portion of the hairs faintly gray.

"This was the only mouse of this species caught. It was taken in the thatch of one of the laborer's huts."— M. A. C.

Oryzomys navus messorius Thomas, to which this specimen is referred, was described from the Kanuka Mountains, British Guiana (altitude not stated). It seems to be a smaller animal than true *O. navus* Bangs, from the Sierra Nevada de Santa Marta, Colombia (altitude 8000 feet), and in view of the wide geographical separation of the two forms it seems better to accord to *messorius* full specific rank.

24. **Oryzomys (Melanomys) venezuelensis** (*Allen*).

Four specimens, Le Cumbra de Valencia, Oct. 15–18.

Indistinguishable from the type series from Quebrada Secca, Cumana, Venezuela (this Bulletin, XII, 1899, p. 203).

"Caught in the little cultivated fields near the crest of the mountains. Apparently not very abundant, as few were caught. In some places the woodland extends over the crest and down the south slope for a short distance, and it is in these patches of woodland that the few people living on the heights make their gardens."— M. A. C.

25. **Rhipidomys nitela** *Thomas.*

Twelve specimens, including both young and adults, Rio Yuruan, March 19–24. The young in first pelage are gray above with a slight tinge of rusty brown, and clear white below; ears in all dark brown. Pelage very short and close on the upperparts, very short and velvety on the ventral surface, as in the small opossums (*Marmosa*).

"These mice live in the thatch roofs of the laborer's houses." — M. A. C.

Sciuridæ.

26. **Sciurus flammifer** *Thomas.*

Rio Mocho (Bull., XXVIII, p. 146).

El Llagual, 2 specimens, males, Jan. 8 and 15.

Length, 556, 570; tail, 280, 298; hind foot, 65, 70. One of the specimens is melanistic, being much suffused with blackish, which largely replaces the usual orange tint.

"This, as well as the other species of squirrel, was not common anywhere on the Caura. The present form varies greatly in color. I one day saw a specimen jet black in color while shooting in the hills at El Llagual. It is a forest resident, as is also the little red species [*Sciurus æstuans gilvigularis*]." — M. A. C.

27. **Sciurus (Guerlinguetus) æstuans gilvigularis** (*Wagner*).

Rio Mocho (Bull., XXVIII, p. 146).

28. **Sciurus griseogena** *Gray.*

Eight specimens: Las Quiguas, 3 specimens, Sept. 5 and 6; San Esteban, 3 specimens, Oct. 29 and Nov. 1; Guarico, 1 specimen, Feb. 4; Paramo de Rosas, 1 specimen, March 14.

These agree essentially in all particulars with two from San Julian, Venezuela, collected by Lieut. (now Captain) W. Robinson in July, 1900, and differ from a large series of topotypes of *S. g. meridensis* Thomas collected by S. Briceño and S. B. Gabaldon in the Montes del Escorial, near Merida, in shorter pelage and in having the red of the lower surface of the tail confined to the edges of the tail instead of heavily covering the whole lower surface. The single specimen from Paramo de Rosas, collected March 14, is the only one in the heavy long pelage of the Merida series, taken mostly in December and January (one in March). Doubtless the season, as well as elevation, has much to do with the length and fullness of the pelage in these two forms.

"This squirrel is abundant throughout the [San Esteban] valley, from the point where the forest begins to the top of the mountains. It is very destructive to the cocoa of the valley and many are shot. Squirrels were also abundant on the Paramo de Rosas and did great damage to the little farms and especially to the tobacco (of which there was a great deal planted), eating off the seed just before it was ripe enough to gather. I found it up to 9000 feet."— M. A. C.

Mustelidæ.

29. **Pteronura brasiliensis** (*Zimmermann*).

Rio Mocho (Bull., XXVIII, p. 146).

"Otters are plentiful in most streams in Venezuela, and are notoriously so in the Rio Apure. I found them numerous in the Rio Mato and Rio Mocho, but very difficult to secure. They are not hard to shoot (I shot six), but as they are almost invariably in deep, swift water, as soon as shot they sink and are carried away. Trapping them seems to present insurmountable obstacles in these regions. They are often seen on the Caura, Mato and Mocho, swimming up or down in bands of 3 to 6 or 8, playing, diving constantly, and blowing like porpoises upon rising. Often they shoot straight out of the water until the whole chest is visible, when they offer a good target. They indulge at times in loud barking or roaring, thrashing about in the water at a great rate. I watched such an exhibition on the Caura, which continued for about fifteen minutes. The two secured on the Mocho River were two of a band of seven which were swimming into the mouth of a creek in front of my camp, where the water was deep and quiet. Three were shot before they could escape into the river, one being secured with the canoe as it floundered on the surface in its death struggles. The other two sank, but in twelve hours they rose to the surface. One was found at once, but the other rose under some rubbish and was not found until too late to save it. I never saw such large ones anywhere as those in the Caura region. Those seen on the Cuyuni were much smaller [probably a different species]." — M. A. C.

30. **Putorius affinis** (*Gray*).

One specimen, adult ♂, San Esteban, Nov. 9. Length, 443; tail, 165; hind foot, 52.

"Killed near the river above San Esteban; rarely seen, owing doubtless to its nocturnal habits." — M. A. C.

31. **Tayra barbara barbara** (*Linné*).

Rio Mocho (Bull., XXVIII, p. 146).

Two specimens; Las Quiguas, adult male, Sept. 14; El Hacha, adult male, Jan. 7. "Shot in forest above Las Quiguas at an altitude of 1400 feet. Common around La Hacha."

These specimens both entirely lack any trace of the usual yellow spot on the foreneck, but otherwise resemble typical *barbara*.

Length, 983, 1020; tail, 400, 380; hind foot, 104, 105.

"Found sparsely in all timbered regions from the sea up to low altitudes only (probably not higher than 2000 feet). It is diurnal as well as nocturnal, and a deadly enemy to poultry, capturing them in the day time when they stray some distance from the house." — M. A. C.

32. **Conepatus marpurito** (*Gmelin*).

One specimen, male (skull lost), El Hacha, Nov. 28. Length, 670; tail, 220; hind foot, 79.

Procyonidæ.

33. **Nasua phæocephala** *Allen.*

Rio Mocho (Bull., XXVIII, p. 147).

"Fairly common in the low country where heavy timber abounds. It is largely nocturnal, but may be occasionally surprised in the early morning or evening rooting, like a hog, around fallen tree trunks and in damp places in the forest. Unless the tracks are examined in these rootings one would be led to think that they were the work of wild hogs." — M. A. C.

Canidæ.

34. **Canis (Carcinocyon**[1]**) thous** *Linné.*

Three specimens, 2 adult males and 1 adult female, La Bomba, Rio Cuyuni, April 19, 20, 21.

These specimens are in exceedingly worn and faded pelage, the tails so greatly worn that the black tips to the hairs have nearly disappeared. Total length, ♂ 990, ♂ 895, ♀ 902; tail, ♂ 320, ♂ 285, ♀ 283; hind foot, ♂ 150, ♂ 140, ♀ 140 (collector's measurements).

"This animal abounds in the whole of the savanna country of Venezuela, I am told, and I certainly saw ample evidence of it on the Caura and in the El Callao district. The natives tell me that it is in the savannas around Valencia and all over the central plateau [where, however, no specimens were collected]. They are almost strictly nocturnal, although on two occasions I saw them abroad in the morning after sunrise. Those caught at La Bomba were trapped with heavy steel-traps placed under half putrid offal suspended from branches of chaparral beside paths. Two were brought into the house alive with a rope around their necks, and after a sharp battle, appeared

[1] *Cf.* Mammals of Southern Patagonia, Princeton University Expeditions to Patagonia, Vol. III, Part 1, 1905, p. 153.

quite subdued, lying down and panting like a dog. They live in the tangled woodland scattered about in the savannas or in holes under rocks." — M. A. C.

At present the Museum collection of mammals contains about 20 specimens of Canids of the *Canis thous* Linné (= *C. cancrivorus* Desmarest) group.[1] The larger numbers are from the vicinity of Bonda, Santa Marta district, Colombia, and represent "*Urocyon*" *aquilus* Bangs, which, as shown below, is only a fairly well differentiated subspecies of *Canis thous*. There are three specimens from the Rio Suarpure, a tributary of the upper Orinoco, and the three listed above from La Bomba, on the Rio Cuyuni, near the western border of British Guiana, all of which seem referable to *C. thous thous*. Three others from Maripa, on the upper Rio Caura, represent *C. thous melampus* Wagner. These were formerly erroneously referred by me to *C. thous savannarum* Thomas,[2] from the savannas of the low coast region of British Guiana, which is evidently a much smaller and stronger colored animal.

The following table of measurements of skulls from these several localities shows that the Bonda series has the skull reduced in length through the shortening of the rostral portion while the interorbital breadth remains unchanged, giving the effect of a shorter and broader skull than is seen in the more southern forms. In details of dentition and general cranial proportions, aside from the exception just noted, there is little differentiation. The coloration is, as is well known, extremely variable, this being well illustrated in the series from Bonda, Colombia, especially manifested in the color of the feet and ears and in the color of the underfur.

Measurements of Skulls of the *Canis thous* Group.

				Total Length	Zygom. Breadth	Upper Toothrow	Interob. Breadth.	Nasals, Length	Nasals, Anterior Width
16926	♂	Suapure,	Ven.	148	80	52	27	52	12
16927	♀	"	"	146	76	52	27	53	12
21309	♂	Maripa,	"	134	74	48	25	50	11
21310	♂	"	"	137	76	44	26	47	12
30626	♂	Rio Cuyuni,	"	143	76	52.5	27	53	11.5
30627	♂	"	"	136	76.5	50	26	49	11.5
30628	♀	"	"	135	75	49	24.7	48	11
14623		Bonda,	Col.	132	70	47	24.5	45	10
14624	old	"	"	127	73	47.5	27.5	43.5	10
14625	old	"	"	134.3	74	49	27	47	10.5
14626		"	"	130	67.2	47	25	44	9.5
14627	old	"	"	139	79	45	27.5	45.2	10
14853	♂	"	"	138	74	51	27	47	10.5
23571		"	"	138	73	51	27	51	11
14851		"	"	—	—	51	28	51	11

[1] On the availability of *Canis thous* Linné in place of *C. cancrivorus* Desmarest, see Thomas, Ann. and Mag. Nat. Hist. (7), Oct. 1903, p. 461.

[2] *Canis* (*Thous*) *cancrivorus savannarum* Allen, this Bulletin, XX, Oct. 8, 1904, p. 342; not *Canis cancrivorus savannarum* Thomas, 1901).

35. **Urocyon cinereoargentea venezuelæ** subsp. nov.

Type, No. 32074, ♂ ad., Tocuyo, Venezuela, Jan. 17, 1911; coll. M. A. Carriker, Jr.

Similar in coloration to *U. c. guatemalæ*, but much smaller, chin and feet darker, and ears larger. External measurements: Total length, 610; head and body, 340; tail, 270; hind foot, 105. (The skull is unfortunately not available for examination, the collector's label bearing the legend "skull lost.")

In coloration this specimen is almost indistinguishable from specimens in similar pelage from Nicaragua, the only difference being that the chin and feet are darker, the upper surface of the feet more varied with dusky, and the sides of the feet blackish brown. The pattern of the white on the throat and cheeks is the same as in all the northern forms of the genus, and the ears are wholly fulvous with a slight mixture of black-tipped hairs apically. The ears are actually larger than in all but one of a series of specimens from Nicaragua, while the general size of the animal (so far as can be judged from a single specimen) is about one-fourth smaller.

This forms the first valid record for the genus *Urocyon* in South America, "*Urocyon*" *aquilus*[1] being really a subspecies of the widely distributed South American *Canis thous* (see above, p. 258). The previous most southern record of the genus known to me is Pozo Azul, Costa Rica (two specimens, also collected by Mr. Carriker),[2] while it is common in Nicaragua.[3] On the probability that it will eventually be found in other parts of northern South America, and the close resemblance in general features of the present specimen to Nicaragua examples of *U. c. guatemalæ*, the Venezuelan form is assigned the rank of a subspecies of the *cinereoargenteus* group. The type locality, Tocuyo, is about 175 miles southwest of Valencia, at an altitude of about 2200 feet.

Felidæ.

36. **Felis pardalis** *Linné* (subsp. nov.?).

One specimen, adult male, Aroa, Bolivar R. R., Dec. 13. Length, 1060; tail, 335; hind foot, 143; total length of skull, 124; mastoid breadth, 53; molar-premolar series, 24.

Similar in size to *Felis sanctæmartæ* but darker and much more heavily spotted, the dark spots solid, not enclosing a lighter area.

"Ocelots were quite abundant in the hills about Aroa."—M. A. C.

---

[1] I am greatly indebted to Mr. Bangs for the opportunity of examining in this connection the type and paratype of his *Urocyon aquilus*.

[2] See this Bulletin, XX, 1904, p. 48.

[3] *Ibid.*, XXIV, 1908, p. 668; XXVIII, 1910, p. 107.

EMBALLONURIDÆ.

37. **Rhynchiscus naso** (*Wied*).

Six specimens: Rio Yuruan, 3 specimens, March 4; San Esteban, three specimens, Oct. 25 and Nov. 15.

"This curious little species was found along the shores of the river [Rio Yuruan], clinging flat to old stubs and the limbs rising out of the water at an angle from the perpendicular. Sometimes a half dozen or more would be flushed from one old stub. They do not hang, but cling flat with wing suckers as well as feet. The same or a closely allied species was seen on the Caura, but none secured.

"[At San Esteban they] were living under the tiles of a house roof and one was caught as it came out at dusk."—M. A. C.

38. **Saccopteryx bilineata** (*Temm.*).

Two specimens, Peru Mine, El Callao, May 13.

"I saw but three of this interesting species, two being secured, the third escaping wounded. They do not hang suspended, but cling flat to the rocks head down, on the side of a wall. They were just within the entrance to a shallow tunnel, and when disturbed, flew out and alighted on the rocky walls outside. I tried every way to catch them with a net but failed and finally had to shoot them."—M. A. C.

39. **Saccopteryx leptura** (*Schreber*).

Two specimens, Peru Mine, El Callao, May 13.

"Upon one of my last excursions I found this pair of bats hanging in a crevice in the roof of a hundred foot tramway tunnel where ore cars were continually passing. They were near the entrance where it was quite light." —M. A. C.

40. **Peropteryx kappleri** *Peters.*

Rio Mocho (Bull., XXVIII, p. 147).

Six specimens: Peru Mine, El Callao, May 13 and 14; Aroa, Bolivar Railroad, Dec. 12.

Five females measure: Length, 74.4 (72–77); length, 14.4 (13–16); expanse, 328.8 (319–334); forearm, 50.2 (50–51).

"[At El Callao], this peculiar species was very rare. I first found two clinging to a perpendicular wall in an old shed back of the house I worked in, and later caught one in a short prospect tunnel. It clings flat to per-

pendicular surfaces, and is the shyest of all the species found, flying away always before I could get near enough to net it.

"[At Aroa the specimen taken was] found in a crevice between boulders on the crest of a hill in the forest."— M. A. C.

41. **Peropteryx canina** (*Wied*).

Seventeen specimens: San Esteban, 12 specimens, Nov. 3–10; Aroa, 5 specimens, Dec. 8.

The males are smaller than the females, as shown by the following measurements:

6 males, length, 56.1 (55–61); tail, 12.7 (12–14); extent, 262.7 (260–265); forearm, 40.9 (40.5–41).

10 females, length, 63.4 (60–67); tail, 14.3 (13–17); extent, 275.4 (272–280); forearm, 43 (42–44).

"This species I first took at a small rocky cave near the coast about seven miles from Puerto Cabello (Las Canteras). They cling flat to the rocks and were not inside the cave but among the boulders at the entrance. When disturbed they flew into the cave, and when pursued outside they promptly returned to their former post. They are incredibly swift of wing and hard to catch. I afterwards found others among masses of limestone rocks on the crest of the ridge above San Esteban."— M. A. C.

Phyllostomidæ.

42. **Chilonycteris rubiginosa rubiginosa** *Wagner.*

Sixteen specimens: 6 males, 10 females, Peru Mine, El Callao, May 7–14.

This series is dichromatic, or at least presents a wide range of color variation that is neither sexual nor due to immaturity. Four specimens are bright reddish brown, four others are dark brown without tinge of reddish, while the rest are of a more or less intermediate shade — dark brown with a slight reddish cast.

The collector's measurements show practically no sexual difference in size, as follows:

6 males, length, 100 (94–103); tail, 24.2 (21–26); alar expanse, 411 (401–422).
10 females, length, 106.6 (92–103); tail, 24.1 (22.27); expanse, 409.2 (400–427).

"These bats were taken deep in the mine tunnels, never near the surface and never in company with any other species, nor were they ever found in

a tunnel less than 500 feet in depth. They are swift of wing and hard to catch and had to be driven to the ends of the tunnels whenever possible, and cornered. With respect to their distribution I found a peculiar state of affairs. You will notice in laying out the series that there are three different shades of color. These different colored specimens were taken in different tunnels which were not connected by stopes or other passage ways."—M. A. C.

43. **Chilonycteris rubiginosa fusca** subsp. nov.

Type, No. 31561, ♂ ad. Las Quiguas, 5 miles south of Puerto Cabello, altitude 650 feet, Venezuela, Sept. 7, 1910; coll. M. A. Carriker.

Similar to *C. rubiginosa* but smaller and darker and less suffused with rufous. The type is dark fuscous brown above with the hair barely perceptibly tipped with grayish; below similar but lighter, the minute grayish tipping of the hairs more evident; membranes blackish brown. Fifteen other specimens from Las Quiguas and San Esteban (near Las Quiguas) are similar and all very uniform in coloration, all being in the dark phase, but two additional specimens are in the fulvous phase; they are, however, paler and much less richly colored than specimens in the 'red' phase of *rubiginosa* from El Callao, eastern Venezuela.

The collector's measurements of the type are: Length, 93; tail, 24; extent of wings, 390. Forearm, from dry skin, 58; third metacarpal, 47.

Average external measurements of 12 specimens: Length, 89.8 (86–94); tail, 22.8 (20–25); extent 391.6 (383–401). Forearm, 18 specimens (from skin), 58.4 (57–60); third metacarpal, 48 (47–51).

Another series of 10 specimens, from Aroa, a short distance to the west, on the Bolivar railroad, is less dark brown and distinctly suffused with rufous; two of them are in the rufous phase and several others are strongly suffused with rufous. This series averages slightly larger, as follows: Length, 91.8 (88–95); tail, 22.1 (21–23); extent, 398.7 (384–404). Forearm, 58.3 (55–59); third metacarpal, 49 (47–51).

"The common species in the 'new' tunnel, where there were perhaps 150 present on my first visit. They prefer to lie flat on the ledges and in the cracks of the rock. This mine is very hot and damp, the temperature ranging from 103° to 108 F. where the bats were found. I found a temperature of 122° F. in some places, but no bats were present there; the highest temperature at which they were found was 110° F." — M. A. C.

The type locality of *Chilonycteris rubiginosa* is Caiçara, Upper Amazon, Brazil, from which locality no material is available for comparison in the present connection. It is assumed, however, that specimens from the Lower Orinoco region are likely to resemble the type form more closely than those from the northern coast region of Venezuela. A series of 10 specimens from El Callao, eastern Venezuela south of the Orinoco, prove to be much larger and much brighter colored, the dark phase being strongly suffused

with rufous and the rufous phase strongly reddish. *C. r. mexicana,* on the other hand, represented by 12 specimens from Amatlan, Terr. Tepic, is much smaller than the several lots from the coast region of northern Venezuela, and extremely pale, in striking contrast with any specimens thus far seen from South America, they presenting in comparison, a strongly bleached appearance.

The difference in size is indicated in the following table based on the length of the forearm and third metacarpal. The several series consist of a nearly equal number of males and females, all fully adult. There is no appreciable sexual difference in size.

		Forearm.	Third metacarpal.
El Callao,	16 specimens	60.8 (59.63)	51 (50–52)
Las Quiguas and San Esteban,	18 specimens	58.4 (57–60)	48 (47–51)
Aroa,	10 specimens	58.3 (55–61)	49 (47–51)
Amatlan, Mex.	10 specimens	55.3 (54–58)	45.4 (44–47)

The collector's measurements from fresh specimens, in the case of the Venezuela specimens (external measurements of the Mexican series are not available),[1] show corresponding differences in size, as follows:

	Length.	Tail.	Wing Expanse.
El Callao,	98.5 (94–103)	24.4 (22–27)	409.6 (401–417)
Las Quiguas and San Esteban,	89 (86–94)	22.8 (20–25)	391.6 (383–401)
Aroa,	91.8 (88–95)	22.1 (21–23)	398.7 (384–404)

The skulls of the El Callao and northern Venezuela series show corresponding differences in the measurements, the El Callao skulls averaging a total length of 23 mm., while those from northern Venezuela average a total length of only 22 mm.

A single specimen from Cacaqualito, Colombia (Santa Marta district), agrees in size and coloration with the specimens from the northern coast of Venezuela.

44. **Chilonycteris personata** *Wagner.*

Twelve specimens (8 females, 2 males, 2 without indication of sex), Aroa, Bolivar Railroad, Dec. 6.

Two (females) are in the bright rufous phase, 3 (1 male, two without indication of sex) are dark mouse brown with no tinge of rufous, and 7 are more or less suffused with rufous, some more strongly than others.

---

[1] The wing expanse for three specimens is given as 14¼ inches = 360 mm.

Measurements.

		Length.	Tail.	Extent.	Forearm.	3d metac.
32124	♂	70	21	290	44.8	36
32132	♂	64	17	283	43	34.5
32112	?	67	17	292	44	35
32127	?	64	17	293	45.2	35
32123	♀	65	16	288	43.6	34
32128	♀	63	15	285	44	34
32129	♀	65	17	299	44	35
32130	♀	66	17	294	44	34
32131	♀	69	18	293	44	35
32133	♀	67	18	296	45	34.5
32136	♀	67	18	283	43	33
32137	♀	69	21	298	44	34
Average		66.3	17.7	291	44	34

This appears to be a rare species in collections, as Mr. Rehn, in his revision of the genus *Chilonycteris* in 1904,[1] had no specimen at hand and gave a transcript of Wagner's description of the species. Miller, in 1907,[2] mentions this as the only species of the genus he had been unable to examine. Dobson, in 1878,[3] took his description from Wagner and Burmeister, there being then no specimens in the British Museum. He, however, described *Chilonycteris psilotis* as a new species, from an unknown locality, and compared it with *C. macleayi*, from which it differs in "the absence of the notch on the outer side of the ear," etc. In his "synopsis of the species" he grouped *C. psilotis* with *C. personata* as regards the structure of the ear. *C. psilotis* apparently may have been based on an orange-colored, rather small specimen of *C. personata*.

In 1902, Miller recognized[4] specimens of *C. psilotis* from the Isthmus of Tehuantepec, Mexico, stating: "Its characters agree in all respects with those given by Dobson, except that the forearm [44 mm. instead of 42 mm.] and tibia are somewhat longer than in the type." Mr. Miller's specimens thus agree in size with the average for 12 specimens of *C. personata* given above.

In order to settle, if possible, the relationship of Mr. Miller's Mexican specimens of *C. "psilotis"* to *C. personata* two specimens from the above described Venezuelan series were sent to Mr. Miller for direct comparison with the Mexican specimens. One of these specimens represented the red phase, the other the dark phase. Mr. Miller (*in. litt.*, Sept. 14, 1911)

[1] A Study of the Mammalian genus *Chilonycteris*. By James A. G. Rehn. Proc. Acad. Nat. Sci. Philadelphia, 1904, pp. 181–207.

[2] The Families and Genera of Bats. By Gerritt S. Miller, Jr., 1907, p. 120.

[3] Catalogue of Cheiroptera in the British Museum, 1878, p. 451.

[4] Proc. Biol. Soc. Washington, XV, 1902, p. 249.

says: "It seems to me that you are quite right in regarding *psilotis* and *personata* as essentially the same. Our specimens of the former, of which I am sending you a skin and two skulls, show slight differences from the South American form, and I should be inclined to keep them distinct (at least as subspecies) until much more material can be examined. You will see that there is a very perceptible difference in the size of the molar teeth and also in the color of the skins in the brown phase."

On comparing these specimens with the Venezuelan series of 12 specimens these differences prove to be inconstant and unimportant. The color of the Mexican skin is *exactly* matched by that of two specimens in the Venezuelan series, and the supposed difference in the size of the molar teeth does not prove to be diagnostic.

More material from Mexico may show the desirability of recognizing a Mexican subspecies, as in the case of *C. rubiginosa*, but in that event it would seem better to give it a new name rather than to employ for it the name *psilotis*, based on a specimen from an unknown locality, probably referable to true *C. personata*.

45. **Pterontus suapurensis** *Allen.*

Twelve specimens, 6 males, 6 females, Aroa, Dec. 6. "Taken in the tunnels of the copper mines."

This species, like *P. davyi*, is dichromatic, three specimens (2 males, 1 female) being of the deep fulvous phase like the type, the other nine being dark fulvous brown, of a much more fulvous cast than the dark (mouse-colored) phase in *P. davyi* and *P. d. fulvus*.

P. suapurensis was described as *Dermanotus suapurensis*, in 1904 (this Bull., XX, p. 229), from a single specimen collected by S. M. Klages at Suapure, Venezuela, which, until the present series was received, has remained unique. The character of large size, separating it at once from *P. davyi*, is amply established by these additional specimens, while the dark phase differs markedly in color in the two forms. The collector's measurements seem to show that the males are slightly smaller than the females, as follows:

Measurements.

		Length.	Tail.	Expanse.
32089	♂	85	24	335
32094	♂	81	22	352
32083	♂	80	21	338
32084	♂	82	23	354
32086	♂	80	22	335
Average of 5 ♂♂		81.6	22.2	345

		Length.	Tail.	Expanse.
32085	♀	85	26	344.5
32081	♀	81	23	349
32088	♀	81	22	339
32091	♀	85	24	357
32092	♀	84	23	353
32096	♀	85	22	345
Average of 6 ♀♀		83.5	23.3	354.6

The measurements of three specimens of *P. davyi* from Carengo, Trinidad, taken by the same collector, are:

		Length.	Tail.	Expanse.
29694	♀	74	22	310
29704	♀	76	21	303
29703	♂	76	21	315
Average		75.3	21.3	309

46. **Micronycteris megalotis** *Gray.*

Twelve specimens, 8 males, 4 females: El Callao (3 specimens), May 10–13; El Hacha (2 females), Nov. 28; San Esteban (4 males, 2 females), Nov. 10 and 14.

Several are young adults, with the phalangeal epiphyses not fully ossified. The male adults average slightly smaller in wing expanse than the females, as shown by the following:

4 females, length, 58.5 (58–60); tail, 11.5 (11–12); expanse, 239 (236–238 with one at 245); forearm, 32.4 (31–34); third metacarpal, 26.9 (26–27.5).

2 males, length, 58, 61; tail, 13, 15; expanse, 232, 233; forearm, 31, 32; third metacarpal, 26, 26.5.

"This was one of the rare species [at El Callao]. It is never found in deep tunnels, but in short prospect tunnels and open-face workings, where light enters freely. They were always hanging in a little cavity in the roof, just within the entrance, and were very wary, leaving the tunnel for the open air at the first alarm. I tried hard to find more of this handsome little species, but failed.

"[Those taken at San Esteban] were found hanging to roots under a small over-hanging bank by the road-side, from where they were shot. Others were taken under projecting banks along railroad cuts. Later a boy brought me three more which he said he caught in a cave. The cave was about 12 miles away and I had no time to visit it." — M. A. C.

47. **Lonchorina aurita** *Tomes.*

Three specimens, all males, San Esteban, Nov. 10. (No measurements nor notes are given by the collector.)

48. **Mimon bennettii** (*Gray*).

One specimen, female, El Hacha, Dec. 3.

"Taken in a hollow tree. There were several more in the same tree but they escaped and none returned to the same tree."—M. A. C.

49. **Phyllostomus hastatus** (*Pallas*).

Thirteen specimens, 11 males and 2 females, all from San Esteban, Sept. 15.

Eleven males measure: Length, 134 (128–140); tail, 18 (14–22); expanse, 611.5 (603–624, with one at 585); forearm, 84.8 (81–86, with only one below 84); third metacarpal, 77 (75–79). The two females are slightly smaller, as follows: Length, 130 (129–131); tail, 18 (16–20); expanse, 605.5 (594–617); forearm, 83.5 (81–86); third metacarpal, 74.5 (73–76).

"These bats were caught in the loft of a house in San Esteban." — M. A. C.

50. **Trachops cirrhosus** (*Spix*).

Three specimens (2 males, 1 female), San Esteban, Nov 8 and 15.

An adult male and female measure: Length, ♂ 101, ♀ 99; tail, ♂ 61, ♀ 62; extent, ♂ 454, ♀ 461; forearm, ♂ 61, ♀ 62; third metacarpal, ♂ 49, ♀ 51. The other male is not fully mature and measures considerably less.

"I found this species *only* in two tunnels, one old and disused, the other new, through which the Puerto Cabello water main passes from the San Esteban valley to the low land back of Puerto Cabello. It is evidently rare, as I saw but two besides the three caught. The male of this species has a globular, subcutaneous musk gland in the middle of the fore-neck."—M. C. A.

51. **Chrotopterus carrikeri** *Allen.*

(Rio Mocho. (Bull., XXVIII, p. 147).

"These bats were all taken in an old hollowed-out termite nest, hanging from a vine in the forest at a height of about fifteen feet from the ground.

When I passed under the nest one flew out, which gave me the clue, and I fired into the nest on suspicion, with the result that it rained bats for a moment." — M. A. C.

52. **Glossophaga longirostris** *Miller.*

Nine specimens (4 males, 5 females): San Esteban (8 specimens), Nov. 3; Guarico (1 specimen), Feb. 7, 1911.

The females average larger than the males, as follows:

4 males, length, 65.2 (63–70); tail, 5.5 (5–7); extent, 275 (263–290), forearm, 36.5 (36–37); third metacarpal, 34 (33–35).

5 females, length, 66.6 (65–71); tail, 6.2 (6–7); extent, 280.5 (262–299); forearm, 37.8 (36–39); third metacarpal, 35.8 (34–37).

These specimens have been compared with topotypes of *Glossophaga elongata* Miller from the neighboring island of Curaçoa, as well as with topotypes of *G. longirostris,* with which latter they agree rather than with the former.

"One of the most abundant bats of this region; I found them in caves, tunnels, houses, etc. It is easily recognized by its long, round, extensile tongue." — M. A. C.

53. **Glossophaga soricina** (*Pallas*).

Eighteen specimens: 14 specimens (8 males, 6 females), Peru Mine, El Callao, May 7–13; 1 specimen, San Esteban, Nov. 7; 3 males, Aroa, Bolivar Railroad, Dec. 12.

The coloration is distinctly reddish brown in all the males and much less so in the females, which are dusky brown. There appears to be no appreciable sexual difference in size.

	Length.	Tail.	Expanse.
8 males:	62 (59–65);	7.3 (6–8);	260 (251–269).
5 females:	62.8 (58–67);	6.6 (6–7);	260.2 (250–265).

54. **Hemiderma perspicillatum** (*Linné*).

Series from three localities: Eleven specimens (5 males, 6 females), Peru Mine, El Callao, May 7–14. Twenty specimens (11 males, 9 females), San Esteban, Sept. 5–7, Nov. 3–9. Six specimens, El Hacha, Nov. 26, 30.

In each series the females exceed the males in size, as follows:

		Length.	Tail.	Expanse.
El Callao,	5 males,	61.1 (65–69);	7 (6–8);	319.6 (305–328).
"	6 females,	69 (65–72);	8.2 (7–10);	337.5 (335–346).
San Esteban,	11 males,	68.3 (65–71);	8 (6–10);	329.3 (311–345).
"	9 females,	68.2 (66–72);	8.6 (6.5–10);	335.5 (313–351).
El Hacha,	2 males,	66 (65–67);	7.5 (7–8);	329 (328–330).
"	4 females,	71.5 (68–74);	7.5 (6–9);	336.8 (316–348).

"This was the most abundant about the mines [Inca Mines, El Callao], being found in the lofts of houses as well as in the outer portion of the tunnels. They never penetrated very deep. I suppose the two shades of color in this form are due to age. The men at the mine nicknamed this species the 'drawingroom bat,' because in the mornings they were always found hanging to the ceiling of the draftsman's office."

"[The San Esteban and El Hacha series were taken] under culverts on the railroad and in a cave in the rocky cliffs along the river a short distance above Las Quiguas. The cave was small and damp, a mere hole in the cliff." — M. A. C.

55. **Sturnira lilium** (*Geoffroy*).

One specimen, El Hacha, Nov. 28.

"Taken in a hollow tree."— M. A. C.

56. **Uroderma bilobatum** *Peters.*

Two specimens, San Esteban, adult male, Oct. 31; Las Quiguas, young female (in first pelage), Sept. 22.

"[One of these specimens was] caught hanging to a banana leaf in a thick cluster of these plants. [The other] flew into a house at night and was caught. This species hangs on leaves in the forest or among bananas, etc.; it never enters caves or hollow trees." — M. A. C.

57. **Artibeus planirostris** *Peters.*

One specimen, male, Cuidad Bolivar, Sept. 17.

"Discovered hanging amongst a thick cluster of leaves in a roadside tree just outside of the town."— M. A. C.

58. **Artibeus cinereus** (*Gervias*).

One specimen, San Esteban, Nov. 9.

"A single specimen of this species was brought to me by a boy, who said he caught it in a small hole in the rocks by the river."— M. A. C.

Desmodontidæ.

59. **Desmodus rotundus** (*Geoffroy*).

Eleven specimens, 3 males, 8 females: El Hacha, 1 (female), Nov. 30; San Esteban, 10 (3 males, 7 females), Nov. 8.

Seven adult females: Length, 81 (75–88); tail, 0; expanse, 414.7 (404–426); forearm, 60.1 (58–62); third metacarpal, 54 (51–55); thumb, 17.2 (17–18).

Three males: Length, 74.3 (73–76); tail, 0; expanse, 375.7 (369–379); forearm, 54 (54–54); third metacarpal, 46.5 (46–47); thumb, 15.3 (15–16). As shown by this series the males are much smaller than the females. The amount of individual variation is large.

"Two colonies of these repulsive creatures were found, one in the 'old' tunnel and one in a small cave on top of a ridge. They were very numerous in the old tunnel, probably 200 in all. They do not hang by the feet when it is possible to find a flat or sloping surface to lie on and frequent holes and cracks in the rock. They run about very rapidly, sometimes making short jumps. They are incredibly strong for their size and when caught become perfectly wild with rage, squealing and making every effort to bite. I can testify to their ability to fight, for I still bear a scar on one finger, where by a single snap my finger was slit to the bone and a small artery severed. The native name for the vampire is 'Chupa Burro,' although they do not distinguish between the real vampire and the other species."—M. A. C.

Natalidæ.

60. **Phodotes tumidirostris continentis** *Thomas.*

Seven specimens, San Esteban, Nov. 10.

Length (7 specimens), 98.7 (96–100); tail, 51.4 (50–54); extent, 280.4 (272–287); forearm, 39 (37–40); third metacarpal, 35.3 (33–36); tibia, 19.2 (19–19.4). There is no sexual difference in size, and the series is remarkably uniform in coloration.

"Taken *only* in the new water tunnel, and seen nowhere else. One end of the tunnel was closed (length about 200 feet) and these little bats always seemed to stay near the closed end. They hung to projections of rock along the sides of the tunnel, but *not* to the roof. They were not abundant." — M. A. C.

Vespertilionidæ.

61. **Eptesicus hilarii** (*Geoffroy*).

One specimen, male, Rio Yuruan, March 25. Length, 99; tail, 42; expanse, 303.

"Captured in the house at night."— M. A. C.

Molossidæ.

62. **Promops milleri** *Allen.*

Eleven specimens, all adult except two, which are only about one-half grown. All are from Eldorado, Rio Cuyuni, April 14.

	Length.	Tail.	Expanse.
2 males:	133.5 (131–136);	44.2 (45–48);	434 (430–438).
7 females:	140 (135–148);	47 (44–50);	422 (412–444).

With the exception of the two young examples, which are deep black, the coloration of the whole series is very uniform sooty brown.

This series is from near the type locality (La Union, Venezuela) of my *Promops barbatus,* based on a single specimen, but this specimen is sharply distinct from any of this series, which, on the other hand, I am unable to separate from the series of *P. milleri* from Guayabamba, Peru.

"These bats were all caught in the loft of a house at Eldorado, where they were hanging in a great cluster on the side of a perpendicular timber. They had evidently occupied the place for some time for a great heap of excrement littered the floor below."— M. A. C.

63. **Molossus obscurus** (*Geoffroy*).

Rio Caura (Bull., XXVIII, p. 148).

One specimen, male, Eldorado, Rio Cuyuni, April 14.

"These bats are always found in the thatch of houses and they crawl about quite actively on a flat surface without attempting to fly."— M. A. C.

Cebidæ.

64. **Alouatta macconnelli** *Elliot.*

Rio Mato (Bull., XXVIII, 148).

Five specimens: El Llagual, 2 old females, Jan. 19 and 21; El Hacha, 2, male and female, Nov. 24 and Jan. 6; Paramo de Rosas, 1 male, March 20.

The 3 specimens from northern Venezuela do not differ appreciably in color or otherwise from 4 others from El Llagual and Rio Mocho. There is a noteworthy sexual difference in color, the males being much more intensely colored throughout than the females.

"Common on the Caura and on the Cuyuni, and in less numbers most everywhere from sea level up to 4000 feet (La Cumbre de Valencia), where heavy forest is found. Its presence is always quickly revealed in a locality by its tremendous roaring, which is really quite awe-inspiring. They are sluggish, morose brutes, impossible to tame, and are more often found in pairs or families than in troops. They will sit curled up for hours in the top of some giant tree, and as long as they believe themselves unseen, will not move, but even when disturbed, never move with the speed or agility of *Cebus* or *Ateles*.

"I have found them to be much troubled with 'screw worms,' especially around the neck. Other species seem to be able to remove them, as a rule. They are very tenacious of life, clinging to a branch after being riddled with shot, and even after death, only dropping after rigor mortis has passed and released the contracted muscles. They invariably howl at the first break of day and usually before a rain-storm. They are invariably very lean of body, being in that respect different from the other species, which at times are found exceedingly fat." — M. A. C.

65. **Ateles variegatus** *Humboldt.*

Rio Mato (Bull., XXVIII, p. 148).

Six specimens, 3 adult females, 1 nearly adult male, a young male and a young female a few weeks old, all from El Llagual (Caura district), Jan. 17 and 20, 1910.

The white on the forehead and cheeks is variable, being very strongly developed in two of the females and entirely lacking in the other; in the nearly adult male it is much less developed than in two of the females.

No.	30629,	ad.	♀,	total	length,	1317;	tail,	810;	hind	foot,	193.
"	30631,	"	♀,	"	"	1339;	"	874;	"	"	192.
"	30632,	"	♀,	"	"	1337;	"	880;	"	"	190.

No. 30629: "Soles black; vaginal appendage and ring about anus partly flesh-color; face black; edges of lips and upper eyelids slightly pale; iris brown."

The young differ from the adults in having no white on the forehead and cheeks and in having the limbs and tail wholly black. One of these specimens is the young of No. 30631, the other the young of No. 30632.

"The least abundant and hardest to shoot of the three species [of monkeys], ranging from sea level up to at least 2000 feet (El Llagual), but preferring the hills and inaccessible mountain sides. They are almost invariably seen in troops of from six to a dozen and are exceedingly shy, owing largely, I suspect, to the fact that they are pursued and shot by the natives for food. The speed with which they are able to travel through the tree tops is almost incredible, as with their long muscular legs and prehensile tails, they go leaping, swinging and crashing from tree to tree, catching now with one foot, now with the tail.

"They are as a rule very fat, and the flesh is really tender, sweet, and well flavored, providing one can forget what he is eating.

"The species is well distributed in Venezuela, but is not found in the scattered tracts of woodland in the savanna country, as are the other two species, but in heavily forested valleys, hills and mountains up to perhaps not more than 400 feet, probably less.

"I have never seen any species of monkey voluntarily descend to the ground in its wild state. All three species invariably carry the young on the back." — M. A. C.

66. **Cebus apiculatus** *Elliot.*

Maripa (Rio Caura), and Rio Mocho (Bull., XXVIII, p. 149).

Eleven specimens: El Llagual, 1 female, Jan. 22; La Bomba, 2 males, April 21; El Hacha, 4 males and 2 females, Nov. 5 and 24–28; Aroa, Bolivar Railroad, male and female, Dec. 14 and 16.

This fine series does not differ from our previous large series from the Rio Caura and Rio Mocho. There is the same wide range of individual variation noted in recording the Rio Caura specimens (*l. c.*, p. 149).

"This monkey I found to be by far the most abundant and least wary of the three species in all places visited on the Caura and in northeastern Venezuela. However they do not, as a rule, ascend to any great altitude, preferring the forest along the streams or anywhere in the comparatively low country. Almost invariably they will be seen in small troops of from a half dozen to twenty, very seldom a pair alone. While not as shy as the other species, they are nevertheless far from easy to shoot, and must be taken by surprise, or else they rapidly make their escape through the high tree-tops. They tame easily and make interesting and effectionate pets if not mistreated.

"Rare in the region of El Hacha and Aroa. They live up on the slopes above the valley, descending occasionally to feed on the corn, etc., planted on the lower slopes." — M. A. C.

Article XI.— NOTES ON TELEOSTEAN FISHES FROM THE EASTERN UNITED STATES.

By John Treadwell Nichols

Plate XI.

CONTENTS.

Moxostoma alleghaniensis, n. sp. p. 275.
Menidia gracilis. p. 276.
A larval *Synodus fœtens*. p. 278.
Chasmodes bosquianus. p. 277.
Stathmonotus tekla. p. 278.

In the following notes the writer records certain recent observations incidental to cataloging the American Museum of Natural History's study collections of fishes.

I. A New Sucker from the Mountains of North Carolina.

Several specimens of an apparently new sucker of the genus *Moxostoma* have recently been sent to the museum by Mr. Morton L. Church, who obtained them at Marshall, N. C., in the extreme western portion of the State, January, 1911. It is interesting to note that this form from the Alleghany region, in its small head and scales, approaches *Moxostoma lesueuri*, the northernmost member of the genus. It differs from allied forms in the small eyes and larger number of scales in the lateral line.

Moxostoma alleghaniensis, n. sp.

Plate XI, Fig. 1.

The type, No. 1830, American Museum Natural History, is a specimen 230 mm. long to the base of the caudal.

Depth contained 4.3 times in length to base of caudal. Head 5.0. Eye 5.3 in head and 2.6 in the interorbital space. Dorsal I, 14, its anterior rays slightly exserted, making its posterior margin shallowly concave. Lateral line scales 49. Mouth rather small, horizontal. Lips full, with parallel grooves, the lower lip broad and with a somewhat deeper groove in the center, truncate behind.

The following table gives the proportional measurements of two other larger specimens and a still larger head.

Length of specimen.	Depth.	Head.	Eye.	Eye in interorbital.	Scales.
305 mm.	4.2	5.2	5.75	2.6	48
310 mm.	4.2	4.75	5.5	2.6	49
Head 94 mm.	—	—	6.5	3.0	—

The above specimens have the dorsal as in the type. The air bladder of the smaller one was examined and found to be in three parts. The teeth of the big head are strongly compressed with slight indications of cusps. They increase in size downward, and the lower ones are thickened at the end.

The alcoholic specimens are white below, darker on the back and opercle, the fins with a decided yellow tinge in but one of the larger specimens.

One hesitates to launch a new name in a region where so many suckers have already been described, but the differences which characterize this form are so constant in the material examined, as to fully warrant doing so. It will be interesting to determine whether, coming from a mountainous region, this species truly approaches *M. lesueuri* of the north (of which the writer has seen no specimen), and also whether it is local or more widely distributed in the Alleghany region.

II. *Menidia audens* Hay, probably a Synonym.

The following note deals with two fishes from widely different localities, yet resembling one another so closely that the writer is unable to find any character to separate them. He believes they should be considered one and the same species, although this treatment will not be thoroughly satisfactory until the form is found in intermediate localities, or some plausible theory for its broken distribution advanced.

In a small, interesting collection of fishes obtained in the spring of 1910 at Moon Lake, Mississippi, by Messrs. Louis Hussakof and Dwight Franklin, of the museum staff, there are a number (22) of *Menidia.* By the locality they surely should be *M. audens* Hay, yet the writer cannot distinguish them from *M. gracilis* (Günther), collected on Long Island.

The smaller scales and different position of spinous dorsal attributed to *audens,* do not hold at all, as is evidenced in the following table (p. 277).

Menidia gracilis (Günther) from Moon Lake.

It is remarkable that the same form occurs in localities so widely separated, and we look forward to examining silverside material from intermediate regions where it possibly has been overlooked.

Length of fish.	Scales in Lateral line.	Original of spinous dorsal.	Eye in head.	Depth in length to base of caudal.
61 mm.	41	Slightly nearer base of caudal than tip of snout	3.0	6.9
60 mm.	40	Equidistant from base of caudal and tip of snout	3.0	6.0
57 mm.	38	Slightly nearer base of caudal	3.0	6.0
57 mm.	35	Equidistant	3.0	6.1
51 mm.	38	Equidistant	2.9	5.9
52 mm.	36	Decidedly nearer base of caudal	3.0	6.0
61 mm.	37	Equidistant	—	5.8
60 mm.	36	Decidedly nearer base of caudal	3.0	5.7
60 mm.	40	Decidedly nearer base of caudal	3.1	6.0
67 mm.	41	Equidistant	3.0	6.1
56 mm.	36	Equidistant	3.0	6.0
61 mm.	38	Slightly nearer base of caudal	3.0	6.2
60 mm.	37	Equidistant	—	6.2
59 mm.	36	Equidistant	3.1	5.7
59 mm.	40	Slightly nearer tip of snout than base of caudal	3.0	6.0
62 mm.	38	Equidistant	3.1	6.2
51 mm.	37	Equidistant	3.0	5.5
——	36	Equidistant	—	5.8
55 mm.	36	Equidistant	3.0	—
——	38	——	—	5.5
50 mm.	38	Equidistant	3.0	6.0
51 mm.	38	Decidedly nearer tip of snout than base of caudal	2.8	6.0

III. On two Recently Described Blennies.

Chasmodes bosquianus (*Lacépède*).

Blennius fabbri Nichols.

In Bull. Amer. Mus. Nat. Hist., Vol. XXVIII, Art. XVI, the writer described a new *Blennius* from Florida, *B. fabbri*. It now appears that this was the young of *Chasmodes bosquianus* (Lac.), and that the gill membranes of the type had been accidently torn free.

Stathmonotus tekla *Nichols.*

Plate XI, Fig. 2.

The type of this species, described with the above, is now figured.

IV. Description of a Larval *Synodus fœtens* (Linn.).

Fig. 1.

The collections of the American Museum of Natural History contain a small *Synodus* (No. 3063) 40 mm. long to base of caudal, which is evidently the young of *Synodus fœtens.* It is much slenderer than grown specimens of this fish, translucent, and with a peculiar series of pigment spots. A description follows.

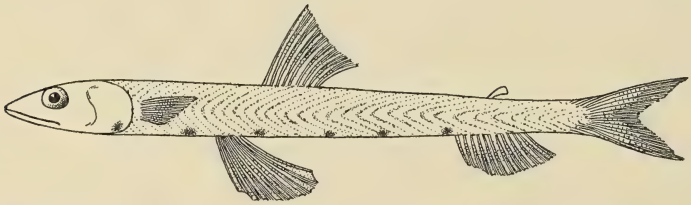
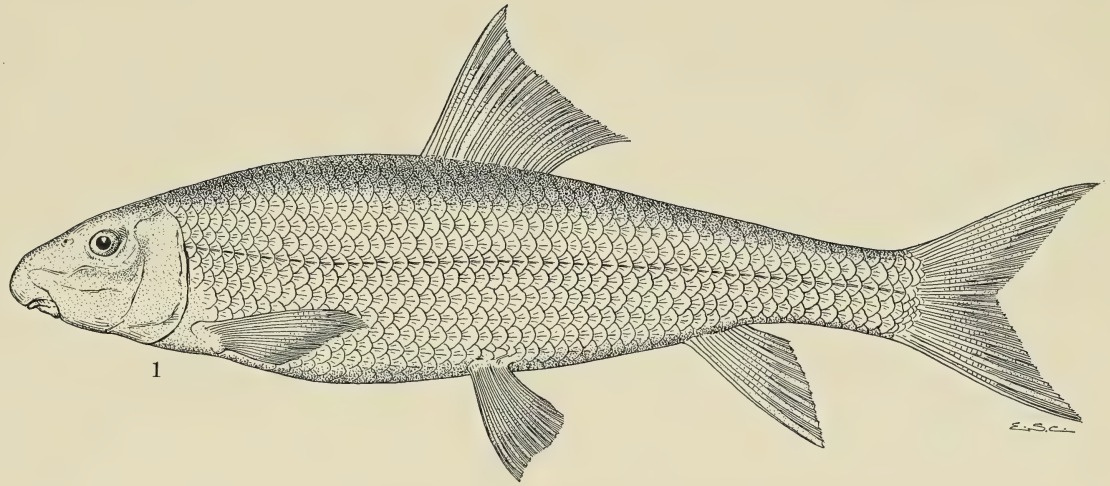
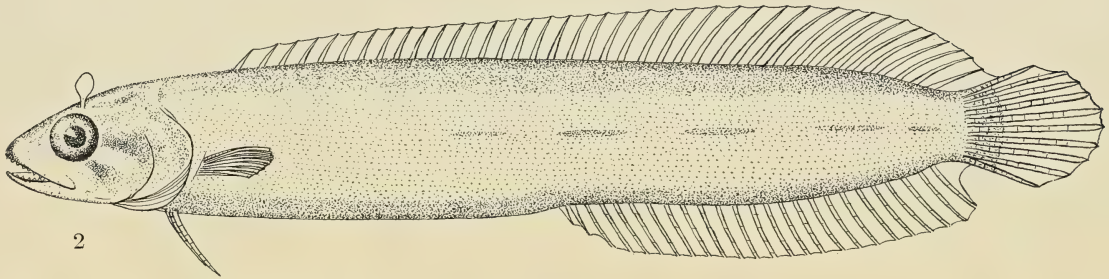


Fig. 1. *Synodus fœtens* (Linn.), young. $\frac{2}{1}$.

Head shaped much as in the adult, $4\frac{2}{3}$ in length to base of caudal. Depth $11\frac{1}{2}$ in that measure. Eye 1.8 in snout. Vent much nearer base of caudal than to ventrals. Teeth conical, directed somewhat backward. Translucent in life, opaque whitish in spirits. Six pairs of oval pigment spots placed one on each side of the ventral line. The most anterior at the edge of the gill cover. The most posterior at vent. Dorsal 9. Anal 12.





1. Moxostoma alleghaniensis, n. sp. $\frac{1}{2}$
2. Stathmonotus teckla *Nichols*. $\frac{1.5}{2}$

59.57,69B

Article XII.—THE SPECIES OF *BRACHYACANTHA* OF NORTH AND SOUTH AMERICA.

By Charles W. Leng, B. S., Honorary Curator of Coleoptera.

Contents.

	Page		Page
Introduction	279	Synopsis of Species and Varieties	286
Habits and Larvæ	280	Descriptions and Notes	294
Description of the Genus	281	Bibliography	327
Distribution and Geographical Variation	285	Explanation of Figures 20–92	331

Introduction.

This genus of the family Coccinellidæ was established in 1842[1] by Chevrolat to contain those species which have the upper surface glabrous, the front tibiæ provided with a short spine or tooth, as indicated by the name, and the number of abdominal segments visible beneath six in the female and (at least apparently) seven in the male.

In the Gemminger and Harold catalogue the following specific names are cited as having been proposed long before the genus was erected:

Coccinella dentipes Fab., 1801, Syst. El., I, p. 381.
" *erythrocephala* Fab., 1787, Mant., I, p. 61.
" *bistripustulata* Fab., 1801, Syst. El., I, p. 383.
" *felina* Fab., 1775, Syst. Ent., p. 87.
" *ursina* Fab., 1787, Mant., I, p. 61.
" *bisquinquepustulata* Oliv., 1808, Ent., VI, p. 1053.

Of these names, *erythrocephala* is cited in error as pointed out by Weise; *felina* is the older name for the insect later named *decempustulata* by Melsheimer, and *bisquinquepustulata* is a synonym of *ursina* as pointed out by Horn. The remainder are still in common use. There were, then, four species described before the time of Thomas Say, who added *albifrons* to the list in 1824. Then came almost simultaneously the descriptions of Mulsant in France and of Melsheimer in this country. The work of

[1] The name appears first in the Dejean Catalogue (1837), spelled *Brachiacantha* but, as no description accompanies the name, the spelling of 1842, when the genus was first described is followed.

Mulsant (Species des Coléoptères Triméres Sécuripalpes) was published in 1851, although the preface is dated Dec. 29, 1848. The names proposed by Melsheimer in 1847 are not mentioned in Mulsant's work and some of the species covered by those names are redescribed by Mulsant, whose names therefore become synonyms. In 1858 and 1859 Dr. Leconte added two names; in 1873 and 1874 G. R. Crotch added several; in 1876 Kirsch described the Peruvian *propria*; and in 1878 E. A. Schwarz described *querceti* from Florida. In recent years further additions have been made by Gorham, Weise, Schaeffer, Nunnenmacher and Casey — the last named giving a synopsis of all the species inhabiting the United States — so that a total of 57 names is now before us. To review and combine these scattered descriptions, with such additions as the material now available permits, is the object of this paper.

The material used includes the collection of the American Museum of Natural History and that of the U. S. National Museum, in both of which specimens from the Biologia Centrali-Americana material are found. It is a pleasure to acknowledge the kindness of Dr. L. O. Howard, chief of the Bureau of Entomology, and of Mr. E. A. Schwarz in connection with the loan from the National Museum. Outside of such Museum material the private collections of Mr. Charles Schaeffer, including a co-type of *arizonica*; of Mr. F. W. Nunnenmacher, including a cotype of *blaisdelli*; of Dr. A. Fenyes, including many Mexican species; and of Dr. A. Sicard, including most of the South American species, have been loaned for study and grateful acknowledgment of the favor is here expressed. Useful specimens have also been obtained from Messrs. Louis H. Joutel, Warren Knaus, R. H. Wolcott, William T. Davis, H. F. Wickham, and Geo. Reineck which have contributed to the completeness of the series examined. In connection with the drawings, acknowledgment should be made of the help of Col. Thomas L. Casey in furnishing sketches of the maculation of the species described by him and details of their abdominal structure, and of Mr. John A. Grossbeck to whose skill is due the satisfactory drawings of the details of the external anatomy and to whose trained powers of microscopic observation is due the accurate representation of the claws.

Dr. Frank E. Lutz has been kind enough to read the entire manuscript and has given many valuable suggestions in the course of its preparation for the press, by which some errors and oversights have been detected.

Habits and Larvæ.

The larva of *Brachyacantha* has been described by Prof. John B. Smith (1886) and, very recently, more completely by Prof. W. M. Wheeler (1911) who gives a figure of a group of larvæ, covered with the characteristic

waxy secretion which, he says, may result from their feeding on organisms which contain large quantities of substances that are readily convertible into wax. The adult larva, covered with the waxy tufts, measures about 10 mm., but after these have been dissolved in chloroform, the body is only 6–7 mm. long, and is of a whitish or pinkish yellow color, with short and feeble legs, small head and obese, elliptical abdomen; each segment has a deeply impressed line in the middle of its dorsal surface; the body is covered with delicate flexuous hairs. The larva pupates within the larval cuticle and the imago emerges about a month later. The species under observation by Prof. Wheeler was *4-punctata*, a specimen having been sent to me for identification. In the case of the larvæ described by Prof. Smith in 1886 the species was said to be *ursina* and the waxy secretion was described as exuding in long strings, giving the larva the appearance of being covered with cotton or hoar frost.

In both instances the larvæ were found in ant-nests, moving slowly about or resting among the root-coccids and root-aphids so abundant during the spring months in the nests of yellow *Lasius* often found under large stones. The Coccids and Aphids, of which the winter eggs are said to be brought by the ants into galleries excavated around roots, feed upon the roots when hatched, secreting meanwhile the waxy substance which is acceptable to the ants. The coccinellid larvæ in turn, are assumed to feed upon the Aphids, or their eggs; and, from the nature of their food, they also become covered with a similar waxy secretion.

The imago is usually found in miscellaneous sweeping or beating of vegetation.

Description of the Genus.

Making a few corrections and additions (which are printed in italics) to the descriptions heretofore published gives the following characters for the genus:

Upper surface glabrous; six visible ventral abdominal segments in the female and apparently seven in the male *of which the last is really a dorsal segment*; anterior tibiæ spinose externally at about basal two-fifths *and with a double edge beyond the spine, variously modified*; fourth joint of maxillary palpi strongly securiform; eyes well developed, very finely faceted and emarginate *by the overlapping lobes of the epistoma*; antennæ short, 11-jointed, the base not concealed by the epistoma; legs rather short and stout, tarsal claws with a large internal, subquadrate or pointed tooth; metacoxal plates attaining the first suture or very nearly, extending along the latter for some distance, then curved strongly forward but scarcely attaining the base externally; epipleuræ foveate for the tips of the hind femora, very narrow, more or less horizontal; epistoma truncate or feebly arcuately emarginate, *and expanded*

into small lateral lobes which overlap the emargination of the eyes; body very convex; *abdomen of male variously modified, usually depressed at middle with the segments variously excavated or bicuspid.*

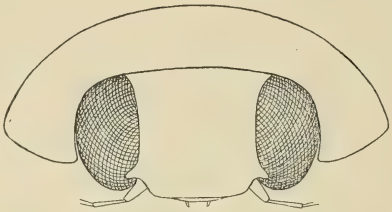


Fig. 1. Head and thorax of *Brachyacantha bistripustulata*, showing the emargination of the eyes by the lobes of the epistoma and the insertion of the antennæ.

The sexes may be distinguished by the presence of seven apparent ventral segments in the male, six in the female; by the male usually having more pale color on the head, the front of the thorax and at the humeral angle of the elytra; and by the special modification of the ventral segments in the male. In one group of the species inhabiting the United States this modification takes the form of two elevated cusps at the posterior margin of the third segment with the fourth and fifth segments depressed. In another group there are no cusps but the fourth and fifth segments are excavated and in a third group there is no depression or excavation. In all that I have examined the fifth segment in the male is always emarginate on its posterior margin and frequently the depression of the segments is arcuately limited in front and the modified parts are impunctured and shining. These sexual characters, which have been mentioned by some authors, especially Weise and Gorham, but have not heretofore been described in detail for all the species, afford valuable characters for grouping the species.

2

3 4 5

Fig. 2. Front leg of *B. dentipes*, showing in profile the tooth of the tibia and the basal tooth of the claw.

Fig. 3. Front tibia of *B. decora*, inclined to show the excavation beyond the tooth and the back margin of same arcuately expanded.

Fig. 4. Front tibia of *B. dentipes* with the back margin of the excavation simple.

Fig. 5. Front tibia of *B. arizonica* with the supplementary subapical tooth.

The form of the anterior tibia and the position and form of its spine are variable and are useful guides in separating the species. The legs are

contractile. The femur is deeply grooved for the reception of the tibia. The tibia is also deeply grooved for the reception of the tarsus but only beyond the spine. The existence of this groove necessarily implies a double edge externally to the grooved part of the tibia, one edge in front and one behind the cavity. In many species these edges are simple, parallel and exactly alike, but in others they differ. In *arizonica* as described by Schaeffer, the tibia has an extra spine near its apex that, viewed from the rear, seems nearly as large as the regular spine. This extra spine will be found more or less developed in all the *ursina* group. In *bistripustulata* and all its allied species the posterior edge is arcuately expanded so that the tibia seems thickest at the middle as described by Mulsant, but sufficient magnification shows the anterior edge to be quite simple, and the swelling to be confined to the lamina-like expansion of the posterior edge. The spine itself varies in size, in curvature and in position. It also *appears* to vary

6 6a

Fig. 6. Claws of *B. dentipes*, showing the subquadrate basal tooth, still more enlarged in Fig. 6*a*. The claw itself is thicker than the tooth which under high magnification appears as a thin process from the lower surface of the claw. Under the microscope the tooth is not in the same plane as the claw's upper surface.

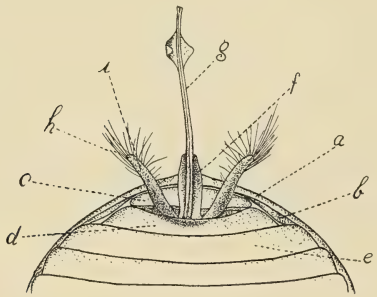
more than it actually does, according to the position in which the insect is held, for which reason little use has been made of its variations. The form of the claws and of the large basal process cr tooth is shown in the figures.

The ornamentation of the elytra is exceedingly variable being constant only in series collected at one time and place and not always even then. As far as the species occurring in the United States are concerned three types of elytral ornamentation can be traced; viz: three pale spots on black ground, five pale spots on black ground, and irregular markings. It requires some imagination, however, to connect all the variations that occur with the group in which they are placed. The groups are indicated by the form of the tibia and cf the male abdomen rather than by the markings.

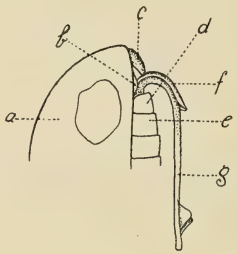
The above refers to the species occurring in the United States. Southward still other modifications of abdomen and other patterns of ornamentation occur. In the Mexican *pygidialis* all the ventral segments except the

first are depressed in the male and each elytron bears four yellow spots; in a Costa Rican species, *aperta*, all the segments except the first, are depressed and provided with cusp like elevations, and the elytra are marked with dark lines on a pale ground. In them, as in our species, strong differences in pattern of ornamentation seem to be correlated with equally strong differences in structure, particularly of the male abdomen. The ornamentation being the more subject to individual and geographical variation the structures described seem to be the safer guides for separation of species.

The genitalia of the Coccinellidæ are seldom found protruding in cabinet specimens. In examining many specimens for secondary sexual characters. only two have been found with the male organs extruded and from one of these the figures have been drawn by Mr. Grossbeck. They are similar to the figures and descriptions given by Verhoeff (1893, plate 3; and 1895) but differ in some respects. The central organ, which he calls "penis plus sipho," is apparently composed of two portions: the basal stouter, the apical longer and thinner. The apical portion, which he calls sipho, appears



7



8

Fig. 7. Extruded genital organs of *B. 4-punctata* ♂ including:

a = edge of elytra seen from beneath
b = edge of dorsal segment
c = so-called seventh ventral segment
d = sixth ventral segment
e = fifth ventral segment
f + *g* = penis + sipho (using Verhoeff's nomenclature)
h = cirrus (using Verhoeff's nomenclature)
i = paramera " " "

Fig. 8. Side view of the genitalia of *B. 4-punctata* with the paramera removed; the same lettering is used as in preceding figure.

to be unusually developed in Coccinellidæ. The lateral view, as shown in Figure 8, makes the basal portion look more like a sheath, partially surrounding the apical portion, than do any of Verhoeff's drawings, made from dissections. The pair of lateral organs, called "paramera" by Ver-

hoeff, are stout, slightly arcuate and divergent when extruded and bear at their extremity a copious brush of hair which is called "cirrus." These paramera in Verhoeff's drawings, representing them within the body, are directed forward. When extruded, they are directed backward, in the same direction as the central organ, as if they were reversed in position. The entire apparatus issues from the body behind the sixth ventral segment and between it and the so-called seventh ventral segment, which therefore appears to be really a dorsal segment, so deflexed as to assume the appearance of a ventral segment.

Distribution and Geographical Variation.

The distribution of the species of the genus *Brachyacantha*, so far as known, seems to be wholly American and the genus seems to be especially developed in Mexico and Central America. There we find the largest number of species, and those that inhabit the United States being nearly all represented in Mexico and none being represented in the far north or in Europe and Asia, we may conclude our species have spread from Mexico and Central America, undergoing slight modifications as they became exposed to colder climates. That this dispersal has been recent may be inferred from the scarcity of species west of the Sierra Nevada, only two having been described (from California and Nevada). If this inference is correct, the varied forms of ornamentation may be regarded as a recent and perhaps ephemeral result of changed environment.

In the case of *bistripustulata*, which barely enters the United States but extends southward to Brazil, only slight changes have taken place. In the case of *dentipes* which is abundant in the warmer parts of our country and rare in Illinois, Virginia and perhaps other northern regions, the pale color is reduced to small spots, the increase in black pigment apparently following the influence exerted by cold and moisture as in the species of *Hippodamia* and *Coccinella*. The numbers of specimens examined is, however, too small to make this certain. In the case of *ursina*, which appears to be rare in Mexico and only uncertainly represented southward by the Peruvian *propria*, we have a species which is widely distributed in the United States and exhibits many geographical variations in ornamentation. Thus *congruens* is the name applied to the race inhabiting the southern Alleghanies (in which region many peculiar forms of Coleoptera, like *Michthysoma* and *Dasycerus* are found); *stellata*, the name applied to a race living west of the Alleghany Mountains; *uteella*, the name applied to a race inhabiting the region immediately east of the Rocky Mountains, and

sonorana, to a closely allied Mexican form. These races are not strongly differentiated, even in maculation. They certainly seem to have resulted from the influence of new environment upon the species as it emigrated from the south.

The total number of species is thirty-nine. Of these,

4 are found in Central and Eastern United States and Canada;
1 is confined to Florida;
3 are confined to the plains east of the Rocky Mountains;
2 are confined to California and Nevada;
7 occur in Mexico or in United States near the Mexican boundary;
12 are confined to Central America;
8 are confined to South America; and
2 extend from United States to South America.

From another point of view:

18 species occur north of Mexico;
19 species occur in Mexico and Central America; and
10 species occur in South America.

As a whole, the genus is best represented in the warmer parts of the American continent. Few records are so far known of the occurrence of *Brachyacantha* in the West Indies; *bistripustulata,* which occurs from Brownsville, Texas, to South America, is abundant in Jamaica.

Synopsis of Species and Varieties.

The modification of the male abdomen is the basis of the following synopsis, supported by the more obvious differences in maculation. The following types of modification are known:

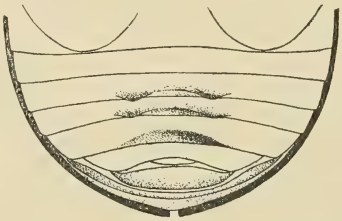
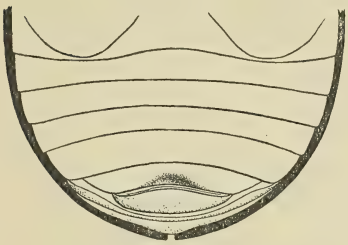


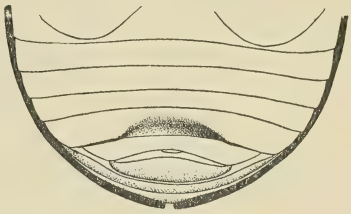
Fig. 9. Abdomen of *B. bistripustulata* ♂ showing the bicuspid third segment.

I. The posterior margin of the third ventral segment instead of being a simply broadly arcuate line becomes elevated on each side of the middle. The elevations may be slight as in *aymardi* or developed into prominent

cusps, overlapping the fourth segment and bent outward from the abdomen as in *bistripustulata* (Fig. 9). The fourth and fifth segments may be similarly modified but to a much less degree. For brevity, this form is indicated in the synopsis by the term "third segment ♂ bicuspid."



10



11

Fig. 10. Abdomen of *B. ursina* ♂ showing the third segment simple, the fifth excavate.
Fig. 11. Abdomen of *B. albifrons* showing the same structure as in *ursina* but still more developed.

II. The fifth segment of the abdomen may be more or less deeply excavated. The excavation is usually like an elongate, curved fovea, abruptly limited and extending transversely across the middle third (or less) of the segment. A similar, but lesser, excavation of the fourth and sixth segment often accompanies it. It is well developed in *ursina* (Fig. 10) and reaches its maximum in *albifrons* (Fig. 11) where the entire hind part of the middle third of the fifth segment is replaced by a deep pit and the sides of the posterior margin are slightly produced over the sixth segment. For brevity this modification is called "fifth segment ♂ excavated" in the synopsis.

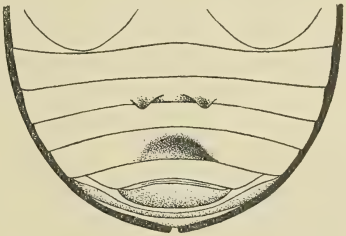


Fig. 12. Abdomen of *B. dentipes* ♂ showing the bicuspid third segment and excavate fifth segment.

III. Both of these modifications occur in the ♂ of *dentipes* (Fig. 12).

IV. In all the preceding modifications the second segment remains simple. In the Mexican *pygidialis* (Fig. 13) the second, third, fourth and fifth segments are depressed at middle and a more or less similar modi-

fication may be observed in *aperta, fenestrata,* and other southern species. The depression may be gently curved and not abruptly limited or it may,

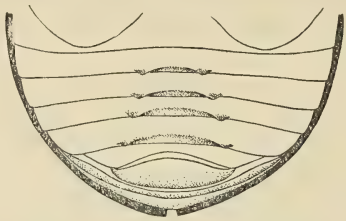


Fig. 13. Abdomen of *B. pygidialis* ♂ showing four segments modified to form a shallow longitudinal fossa.

as shown in the figure, be limited by a raised margin and slightly tuberculate at either side. The available material has not been sufficient to study all the variations assumed by this modification. For brevity it is called "longitudinal fossa" in the synopsis.

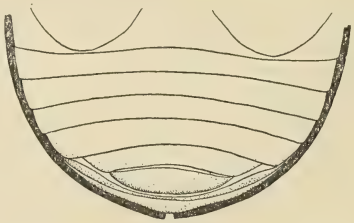


Fig. 14. Abdomen of *B. lepida* ♂ showing none of preceding modifications.

V. There are a few species like *lepida* (Fig. 14) and *querceti* in which there are no such modifications of the abdominal segments. In such the male is known by its having seven visible segments beneath.

There are a few species of which the males are undescribed and not represented in the material. Fortunately all have such peculiar markings that they are easily recognized. To avoid ambiguity I have placed them at the beginning of the synopsis.

There is no uniform pattern of maculation in *Brachyacantha.* Many species have five pale spots on each elytron, some have three instead of five; these spots, in some varieties, become confluent; in others, become partly obliterated by extension of dark pigment. There are also species with patterns of maculation composed of four spots, or not composed of spots at all; these in the synopsis are described as "unusual." The same term is applied to the juxta-scutellar pale spots of the pronotum observed in a few species and to the pale spot on the pygidium of *B. pygidialis.*

Males unknown.

Upper surface ivory white; a large common discoidal orbicular patch black, just cutting the base of the pronotum and extending to two-thirds the length of the elytra. 2.5 mm. Ecuador . . . . . **buckleyi** Cr. (p. 294)

Upper surface black; head, anterior portion of pronotum, and six spots on each elytron, of which the three outer are connected with pale margin, yellow. 2.5 mm. Salvador . . . . . **duodecimguttata** n. sp. (p. 294)

Upper surface pale; head, broad median vitta on pronotum dilated behind, margins of elytra and an abbreviated line on each, black. 3.5 mm. Bolivia. **bilineata** Weise. (p. 295)

Upper surface black; front angles and very narrow front margin of pronotum, also humeral, subapical and faint discal marks on elytra, pale. 1.6 mm. Sapucay, Paraguay . . . . . **trimaculata** n. sp. (p. 295)

Upper surface black; front angles of pronotum, humeral lunule and an irregular vitta on elytra, dilated externally at middle, pale. 2.2 mm. Sapucay, Paraguay. **sicardi** n. sp. (p. 295)

Males known; ornamentation not as above described.

Abdomen ♂ with 3d segment bicuspid, 4th and 5th segments excavated or simply depressed;

Anterior tibiæ with the margin arcuately expanded beyond the spine; each elytron with at most three pale spots besides the humeral spot (except in *tau*);

Abdomen ♂ with the 4th and 5th segments depressed not excavated; form nearly circular . . . . . *Group 1.* (p. 289)

Abdomen ♂ with the 4th slightly, 5th segment deeply excavated; form broadly oval. . . . . *Group 2.* (p. 290)

Anterior tibiæ with the margin simple beyond the spine; elytra pale with a black pattern;

Abdomen ♂ with the 4th and 5th segments depressed, not excavated. *Group 3.* (p. 291)

Abdomen ♂ with 5th segment abruptly excavated, 4th less deeply excavated, 3d not bicuspid; anterior tibiæ not expanded at middle, swollen more or less at apex (with supplementary spine near apex in *arizonica*); each elytron with at most five spots including the humeral spot; (pale with black markings in *albifrons*). *Group 4.* (p. 291)

Abdomen ♂ without bicuspid margin to 3d segment and without abrupt excavation on fifth segment;

Abdomen ♂ with a longitudinal fossa; markings of pronotum and elytra unusual (see p. 288) . . . . . *Group 5.* (p. 293)

Abdomen ♂ like that of ♀ except for the emarginate 5th segment and extra or 7th segment. Maculation unusual (see p. 288) . *Group 6.* (p. 293)

Group 1.

Abdomen ♂ with third segment bicuspid at posterior margin; 4th segment feebly imitating the form of the third; 5th segment slightly depressed and polished at middle, emarginate at posterior margin; 6th segment arcuately strongly depressed;

none excavated. Anterior tibiæ with double margin of which one side is arcuately expanded beyond the spine. Each elytron marked with three large pale spots besides the small humeral spot of male; form very broadly oval, almost circular.

The only species occurs from Brownsville, Texas southward to Brazil and is 3.0 to 4.5 mm. . . . . **bistripustulata** Fab. (p. 296)

The variations in its maculation have caused the following varieties to be named.

Each elytron with three large, entirely separate spots besides the humeral spot, sometimes lacking . . . . . *typical*.

Marginal spot connected with humeral . . . . var. *guttata* Weise.

Marginal spot more or less broadly connected with discal. var. *decora* Csy.

Marginal spot broadly connected with humeral and discal spots. Quiché, British Honduras . . . . . var. *quichiana* n. var.

Marginal spot broadly connected with the subapical spot. Rincon Antonio, Oaxaca, Mexico . . . . . var. *obscura* n. var.

All the spots connected . . . . . var. β Mulsant.

Size much reduced, spots as in typical form . . . var. *minor* n. var.

Group 2.

Abdomen ♂ with third segment bicuspid at posterior margin; 4th segment with a shallow transverse excavation, curved at either extremity; 5th segment with a similar excavation, but much deeper and more definitely limited; 6th segment similar to 4th. Anterior tibiæ expanded at middle nearly as in Group 1. Each elytron marked with an interrupted fascia before the middle and a subapical spot, but the fascia may be divided or lacking and the subapical spot may disappear, and, as in *tau*, the pale color of these markings may coalesce. Form broadly oval, subparallel at sides.

Pronotum black with at most pale anterior margin and angles in ♂;

Elytra with antemedial fascia, broadly interrupted at suture, narrow or broad, complete or divided, and subapical spot, 3.5 to 5.2 mm. Ontario to Texas, Virginia to Arizona; Costa Rica . . . . . **dentipes** Fab. (p. 300)

The fascia complete, narrow . . . . . *typical*.

The fascia divided into two small spots on each elytron. Virginia var. *separata* n. var.

The fascia broad, covering one third of the elytron. 5.2 mm. Kansas. var. *socialis* Csy.

Size much reduced, markings as in typical *dentipes*. Costa Rica. var. *americana* n. var.

Elytra marked only with a broad fascia interrupted at suture. 4.5 mm. Texas, Arizona, Mexico . . . . . **subfasciata** Muls. (p. 302)

Elytra without the fascia, marked only with a subapical spot.

Subapical spot rounded. 5 mm. Texas, Costa Rica. **quadrillum** Lec. (p. 303)

Subapical spot extending along the posterior third of side margin. 3.6 to 4.2 mm. Mexico to Venezuela . . . **erythrura** Muls. (p. 302)

Elytra with the fascia and the subapical spot more or less confluent. 4.5 to 5.0 mm. Nevada, California . . . . . **blaisdelli** (p. 304)

Pronotum pale with irregular black basal mark in ♂, extended through the middle to apex in ♀;

Elytra pale with black basal fascia, suture black, with or without other black spots. 4.7 mm. Nebraska, Montana . . . . **tau** Lec. (p. 305)

Group 3.

Abdomen ♂ with the third segment bicuspid, the succeeding segments only slightly depressed; anterior tibiæ not expanded at middle, simple beyond the spine; elytra pale with the suture and with or without other marks, black, coalescent in *conjuncta*.

Elytra pale with black sutural border feebly expanded at one fourth the length, and black margin covering laterally only the epipleuræ and little wider at apex. 5.0 mm. Mexico . . . . . **westwoodii** Muls. (p. 305)

Elytra pale with sutural border, a common sutural spot near the base, a subhumeral spot and a larger subapical spot, black. 4.5 mm. Mexico. **aymardi** Gorham (p. 307)

Elytra pale with sutural border, wider at apex, and three small spots, one subhumeral, two close together, transverse behind the middle, black. 6.0 mm. Mexico. **cryptocephalina** Gorham (p. 307)

Elytra with black markings greatly extended so as to leave only five pale spots, two covering the entire base and forming posteriorly a festooned border, two, transverse about the middle, one subapical. 3 5 mm. Mexico. **conjuncta** Muls. (p. 306)

[Note: Larger series of the species included in group 3 may necessitate reducing some to varietal rank.]

Group 4.

Abdomen ♂ with the third segment simple, not bicuspid, at most feebly depressed; 4th segment more or less excavated; 5th segment usually deeply, abruptly excavated, the excavation transverse and curved backwards at ends; 6th segment similar. Anterior tibiæ not expanded at middle but with a more or less well defined swelling or a supplementary spine at apex. Each elytron at most with five pale spots, including the humeral spot, any of which may become confluent or may be in part lacking.

Form very broadly oval, elytra black with all five spots present . . . . 1.

Form very broadly oval, spots indistinctly outlined, or partly or wholly confluent, leading in extreme cases to pale elytra . . . . . 2.

Form very broadly oval, some of the spots lacking . . . . . 3.

Form broadly oval, sides subparallel, elytra pale with black markings, which may become so expanded as to leave pale spots . . . . . 4.

1. Elytra black with five distinct pale spots on each; the humeral spot always small. 2 to 3.6 mm. U. S. and Mexico . . . . . **ursina** Fab. (p. 309)

The basal spot on the margin;

The basal spot semicircular, the black area of the pronotum biarcuately limited in the ♂ . . . . . *typical.*

The basal spot nearly circular. 1.9 to 2.1 mm. Indiana. var. *stellata* Csy.

The black area of the pronotum truncately limited in ♂. 2.1 to 3.6 mm. North Carolina . . . . . var. *congruens* Csy.

The basal spot very narrowly separated from the margin; basal, humeral, marginal and discal spots at the corners of an oblong rectangle (not a square as in typical *ursina*);

Spots of usual size. 3.6 mm. Utah . . . var. *uteella* Csy.
Spots very small. 3 mm. Chihuahua . . . var. *sonorana* Csy.
Similar to *ursina* but with all the spots very large and distinctly outlined. 2.7 mm. Brownsville, Texas . . . . **testudo** Csy. (p. 312)
Similar to *testudo* but without the humeral spot and with the marginal spot between the basal and the discal in distance from the base. 3 mm. Mexico. **octostigma** Muls. (p. 311)
Similar to *ursina* but much smaller. 1.5 to 2 mm. United States. **felina** Fab. (p. 312)
Basal spot wider than long, forming a pale line along the base. *typical*
Basal spot normal, markings as in typical *ursina*. 15 mm. Pennsylvania. var. *10-pustulata* Mels.

1a. Elytra black with five pale spots, one basal, one humeral, one round behind the middle, one marginal semiorbicular, one large transverse subapical. 2 to 3 mm. Peru . . . . . **propria** Kirsch (p. 313)

1b. Elytra black with five distinct pale spots on each, the humeral spot large and extending along the side margin but not connected with the marginal spot. 2 to 2.75 mm. Paraguay and Brazil . . . . . **australe** n. sp. (p. 313)

2. Elytra black with the five spots indistinctly outlined, or partly confluent, or wholly confluent forming pale elytra; or with the marginal spot broken into two small spots or wholly lacking; the confluence of the humeral and basal spots apparently always resulting in the base of the elytra being pale;
Outline of spots always indistinct, partial or complete confluence usual; supplementary spine at apex of tibia of usual size. 2.5 mm. Texas, Louisiana. **bollii** Cr. (p. 314)
Outline of spots more distinct; marginal spot lacking, small or broken; humeral and basal spots usually confluent, confluence of other spots infrequent; supplementary spine at apex of tibia very large, nearly equal to regular spine. 2.5 to 3.0 mm. Arizona . . . . . **arizonica** Schffr. (p. 314)

3. Elytra black with one or more of the usual spots lacking except in *flavifrons* where even the discal spot may be represented by a very small dot;
The basal spot only lacking;
Form broadly oval, tibial spine long and slender. 2.5 to 3 mm. Northeastern United States . . . . **indubitabilis** Cr. (p. 315)
Form more oblong, tibial spine short and blunt;
Marginal and discal spots parallel and both a little behind the middle. 3 mm. Colorado . . . . . **fenyesi** n. sp. (p. 316)
Discal spot oblong, in front of the middle and of the marginal spot. 3 mm. Santa Fe, Mex. . . . **mexicana** n. sp. (p. 316)
Discal spot very small or lacking, humeral and marginal also often absent; form nearly circular. 22 to 3.5 mm. Eastern United States. **4-punctata** Mels. (p. 316)
The humeral spot absent in ♀, present in ♂ (*basalis* Mels.) and distinct from basal spot . . . . . *typical*
The humeral spot present in ♀ as well as in ♂, in the latter sex confluent or nearly so with the basal spot. 2.2 mm. . . var. *confusa* Muls.
The marginal, as well as basal and subapical spots, always present. The discal spot occasionally discernible but always very small. 2.6 mm. var. *flavifrons* Muls.

4. Form broadly oval, sides subparallel; abdomen male with 4th segment slightly excavated, fifth segment very deeply arcuately excavated, the excavation reaching nearly to anterior margin of the segment, the sides of the posterior margin on each side of the excavation broadly curved and produced over the sixth segment;
   Elytra pale, suture bordered with black and two discal spots black. 4 to 4.5 mm. Montana, Nebraska, Colorado and Kansas . **albifrons** Say (p. 320)
   Elytra pale, suture bordered with black which expands at one fourth and three fifths and two discal spots black more or less connected with each other and the expansions of the sutural border. 4.1 mm. Colorado. **illustris** Csy. (p. 320)
   Elytra pale, suture bordered with black and two discal spots of which the anterior is connected with the suture. 3.7 mm. California . **pacifica** Csy. (p. 321)

[Note: Intergrading specimens almost justify reducing *illustris* to a variety of *albifrons*.]

Group 5.

Abdomen ♂ without the bicuspid posterior margin of 3d segment or excavation of 5th segment but with a longitudinal fossa extending variously from the second segment to the apex of the abdomen. Ornamentation of pronotum or pygidium peculiar in each species as follows:

Pronotum black with the sides broadly flavous and two discoidal oval spots also flavous. 3.25 mm. Mexico to Panama . . **fenestrata** Gorham (p. 322)
Pronotum pale whitish testaceous with a black broad arrow mark. 4 mm. Costa Rica . . . . . **cachensis** Gorham (p. 322)
Pronotum yellowish white with a black V-shaped mark. 3.3 mm. Costa Rica. **aperta** Weise (p. 323)
Pronotum black at base, pale in front. Pygidium black with an orange spot. 4.5 mm. Mexico . . . . . **pygidialis** Muls. (p. 323)

Group 6.

Abdomen of ♂ without any special modification.

Elytra black;
   Each elytron marked with a subquadrate humeral and a rounded subapical spot orange red. 2 to 2.75 mm. Florida . . . **querceti** Sz. (p. 324)
Elytra pale;
   Elytral markings including a common sutural vitta often expanded about the middle into a large rounded spot;
      Pronotum with pale area in front with four indents from black area;
         Elytra with discal spots distinct from sutural vitta. 2.5 to 3.6 mm. Mexico and Costa Rica . . . . . **lepida** Muls. (p. 324)
         Discal spots connected with sutural vitta. Guatemala. var. *confluens* n. var.
         All black markings reduced, no common sutural spot. Costa Rica. var *reducta* n. var.
      Pronotum ♀ black with sides narrowly pale; elytra with two discal spots, a narrow sutural margin and a large round common spot black. 3.6 to 4.8 mm. Brazil . . . . . **sellata** Muls. (p. 325)
      Pronotum ♀ black with sides and front margin narrowly pale; elytra as in *sellata*. 3–4 mm. Argentine and Paraguay. **bruchi** Weise (p. 326)

Descriptions and Notes.

Following will be found the bibliography of each species and its varieties, accompanied by copies of the original descriptions and such notes as seem necessary to amplify the characters given in the synopsis, with particular references to the distribution as far as known. In some instances, on account of scanty material, little can be added to the original description given by the author of the species.

Males unknown.

B. buckleyi *Crotch.*

1874. Revision of the Coccinellidæ, p. 210.

The original description is "rounded, sub-depressed, punctuation coarse and rather close, pectus and ventral segments in the middle black, legs and upper surface ivory white; a large common discoidal orbicular patch black, just cutting the base of the thorax and extending to two-thirds the length of the elytra." Fig. 76.[1]

Length: 2.5 mm.

Habitat: Ecuador (type locality), Cayenne.

Figure 76 is drawn from a specimen from Cayenne loaned by Dr. A. Sicard.

B. 12-guttata n. sp.

Broadly oval; black above and beneath with the head, anterior portion of pronotum and six spots (of which the three outer are connected with the pale margin) on the elytra yellow. Beneath, the legs, epipleuræ, sides of prothorax and head are yellow. Entire upper surface finely rather distantly punctate. Head entirely pale; pronotum black at base, pale in front and at sides, the black area covering $\frac{5}{6}$ of the base, biarcuately sinuate and divided by a pale narrow line almost reaching the base; elytra black, shining, with humeral and basal spots, marginal and discal spots, posterior marginal and subapical spots all approximately equal in size, and a complete narrow pale margin extending from humerus to suture at apex and connecting the three external spots. Anterior tibiæ, with the usual tooth, large and straight, the outline of the tibia beyond the tooth straight. Male unknown. Fig. 90.

Length: 2.5 mm.

Habitat: Izalco, Salvador. One female collected by Fred'k Knab.

Type in U. S. Nat. Museum.

---

[1] For Figures see pp. 330, 331.

B. bilineata *Weise.*

1902, Deutsche Ent. Zeits., p. 170.

The original description reads:

"Breviter-ovalis, subtus nigra, pedibus testaceo-flavis, supra albido-flava, vertice, vitta lata media postice dilatata prothoracis, scutello, marginibus elytro singulo lineaque, postice abbreviata, nigris; capite thoraceque dense, elytris minus crebre sed parum fortiter punctulatis.— Long. 3, 5 mill. Bolivia."

"Die Mittelbinde des Halsch. nimmt an der Basis mehr als die mittleren beiden Viertel ein, verengt sich davor schnell in concavem Bogen jederseits auf ½ der Breite und lauft dann mit annahernd parallelen Seiten bis in die Nahe des Vorderrandes, wo sie ungefahr so breit als die Stirn ist. Jede Decke ist schwarz umsaumt und mit einer schwarzen Langslinie cersehen. Der Nahtsaum dicht beim Schildchen, das aufsere Drittel des Basalsaumes und der Seitensaum sind sehr schmal, feiner als die ubrigen Theile des Saumes. Die Langslinie ist etwa so breit als der innere Theil des Basalsaumes, zieht von diesem aus uber die Schulterbeule bis ⅔ der Lange nach hinten, ist den Seiten, denen sie nicht ganz parallel lauft, bedeutend mehr genahert als der Naht und hinter der Schulter an der Aussenseite in einem weiten und sehr sansten Bogen kaum merklich ausgerandet. Die Bauchlinien bilden einen flachen Bogen, welcher ein ganzes Stuck den Hinterrand des ersten Segmentes beruhrt."

This species I have not been able to see, hence no figure can be given.

B. trimaculata n. sp.

Black; legs, front angles and extremely narrow front margin of pronotum yellow; elytra with humeral spot yellow, small discal spot nubilously reddish, larger, subapical slightly transverse spot reddish. The humeral spot extends with narrow equal width to one fifth the length of the outer margin. The discal spot is very indistinctly outlined. The subapical spot is definitely outlined, narrowly separated from apical margin and parallel thereto, more widely separated from the lateral margin and from the suture, irregularly rounded in front. The discal and subapical spots are reddish, the humeral is yellow. The surface above is finely punctulate, the punctures separated by more than their own width; beneath more coarsely punctate. The spine of the anterior tibia is small, beyond it the edge of the tibia is irregular. Male unknown. Fig. 91.

Length: 1.6 mm.

Habitat: Sapucay, Paraguay, collected by W. F. Foster in March.

Type in U. S. Nat. Museum.

B. sicardi n. sp.

Black; legs, front angles of pronotum, humeri and broad irregular elytral vitta, dilated before the middle and involving more than half the surface, yellow. The humeral spot extends along the base to outer fifth and along the lateral margin to basal fourth and is arcuately limited within. The elytral vitta commences at the base, extending from near the scutellum to the middle of the base, extends thence

broadly and with nearly parallel sides to about the middle of the elytra where it expands, almost reaching the margin, but remaining more distant from the suture; at four fifths it is again contracted and its apical extremity is narrowly separated from the margin, apex and suture. Upper surface finely punctulate, punctures separated by more than their own width; beneath a little more coarsely punctate. Tooth of anterior tibia small, tibia otherwise simple. Male unknown. Fig. 92.

Length: 2.2 mm.

Habitat: Sapucay, Paraguay, collected by W. F. Foster in February.

Type in U. S. Nat. Museum.

Dedicated to Dr. A. Sicard of St. Malo, France, in recognition of his work on the Coccinellidæ of Madagascar.

Group 1.

Abdomen ♂ with third segment bicuspid, fourth and fifth not excavated; form nearly circular; anterior tibiæ with the margin arcuately expanded beyond the spine; each elytron with three pale spots (besides the humeral spot) separate or variously connected. All the specimens in which these characters occur seem to me, being separable only by modifications of a uniform color pattern, to represent varieties of *bistripustulata.*

B. bistripustulata *Fab.*

1801, Systema Eleutheratorum I, p. 383. Muls. 1851, p. 528; Weise, 1904, p. 361; Casey, 1899, p. 119;

B. 9-pustulata Klug. Dej. Cat. 3 ed. p. 458 (♀);

B. erythrocephala Gorham, 1899, p. 188; Crotch, 1874, p. 211.

Black, shining; thorax with broad yellow or red margin, each elytron with three yellow or red spots, two about the middle, one behind them, subapical. Body beneath black, legs red. In the males there is more pale color than in the females, the head, the anterior margin of the thorax and the meso-epimera are pale and there is a small humeral pale spot on the elytra. The tooth of the front tibia is large and slightly curved and the posterior margin of the groove behind the tooth is arcuately expanded. The sexual modification of the ♂ abdomen affects the third, fourth and fifth segments. The third is broadly, arcuately emarginate, the emargination limited on either side by a small elevation, all the edge of the emargination being polished. The emargination of the fourth segment is equally wide but not so deep and it is not conspicuously elevated. The fifth is broadly simply emarginate and all three are depressed through the centre.

Length: 3.0–4.5 mm.

Habitat: Brownsville, Texas, southward throughout Mexico, Central America and South America to Obidos, Brazil; also Jamaica. Gorham gives many localities in Mexico and British Honduras, Guatemala, Nicaragua, Costa Rica, Panama, Colombia, and Peru.

Original description: "143. C. coleopteris atris, nitidis: punctis sex rubris, thoracis margine rufo. Habitat in America meridionali. D. Smidt. Mus. D. de Schestedt. Media. Caput rufescens. Thorax ater, nitidus, margine late rufo. Elytra atra, nitida, punctis tribus rufis 2. 1. Corpus nigrum pedibus rufis."

Great differences exist in maculation. In typical *bistripustulata* (Figs. 81 ♂, 82 ♀) the spots of the elytra are (*fide* Mulsant, who inspected the type preserved in the Copenhagen Museum) orange yellow (♀) or pale yellow (♂) arranged two in a transverse line, the internal subrounded and covering from the internal sixth to about three fifths; the external, a little smaller, almost a triangle with the base narrowly separated from the outer margin; the third and largest of all sub-orbicular, subapical, at least as near the suture internally as the first named spot, and almost reaching the external margin, a little more distant from the apical margin. The type localities are South American: Colombia for *bistripustulata* and Carthagena for Klug's unpublished *9-pustulata*. In the many specimens examined (about 150) the typical form seems to come from the more southern regions.

The following varieties have been found.

guttata Weise, Stett. Ent. Zeit., 1885, p. 231.
decora Casey, Journ. N. Y. Ent. Soc., VII, 1899, p. 119.
quichiana n. var.
obscura n. var.
minor n. var.
β Mulsant, Spec., 1851, p. 528.

B. bistripustulata guttata *Weise.*

1885, Stett. Ent. Zeit., p. 231.

Original description: "Nicht nur bei dieser, sondern auch bei den meisten anderen Arten besitzen die Männchen ganz bestimmte Geschlectsauszeichnungen, die noch nicht gehörig berücksichtigt worden sind. Im allgemeinen gilt für die ganze Hyperaspis-Gruppe die Regel, dass das ♂ einen Ueberschuss von der gelben Farbe der Zeichnung erhalten hat, der sich am Kopfe, an der Mittelbrust, den Beinen und oft in einer Humeralmakel zeigt; wichtiger ist die verschiedene Bildung der Abdominalringe."

"Beim ♂ der vorliegenden Art ist der dritte Bauchring angefähr im mittleren Fünftel in Eine schwach nach hinten gerichtete Querleiste ausgezogen, die in der Mitte am niedrigsten ist; die folgenden Segmente besitzen einen mit der Querleiste gleichbreiten bogenförmigen schwachen ausschnitt, in welchem der Hinterrand niedergedrückt, zugleich, glänzender ist als die höheren Seitentheile. Erst diese Bildung gab mir die Gewissheit, in einer Brachyacantha von Cauca in Columbien (Staudinger) die ich für eine von *bistripustulata* verschiedene Art hielt, nur eine Varietät zu besitzen welche den Namen *guttata* verdient. Bei derselben ist Makel 1, vor der Mitte am Seitenrande, stets gestreckt, länger als breit und nie quer, wie beider in Mittel und Nordamerika häufigen Stammform, Makel 2 ander Naht, selten Klein und rund, sondern meist gross und länglich, Makel 3 endlich ist nie so stark quer wie beiden mexikanischen Examplaren, länglicher, und reicht weiter nach vorn. Ausserdem zeigt Makel 1 das Bestreben, sich in die Länge auszudehnen (bei den ♂ ist sie deshalb nicht selten mit der Kleinen Basalmakel unter der Schulterbeule verbunden), während dieselbe Makel der Stammform sich der Quere nach verbreitert und häufig mit Makel 2 verbindet. Das ♀ hat nur einen schmalen dunklen Saum am Vorderrande des Kopfschildes."

This variety (see Fig. 83) differs especially in the form of the marginal spot which instead of being small and triangular is extended along the margin until in the ♂ it nearly or quite meets the small humeral spot. It was described from Cauca in Columbia.

B. bistripustulata decora *Casey.*

1899, Journ. N. Y. Ent. Soc., VII, p. 119.

Original description: "Elytra never conspicuously pale or maculate at base, each with two transversely confluent pale spots before the middle and a subapical spot, the confluent pale spots very nearly separated; male with a pale oblique humeral spot which is absent in the female; head pale in the male, the pronotum pale, with a large and abruptly defined median black area from the base to apical fifth or sixth, deeply emarginate at each side; female with the head pale, sometimes narrowly darker at the edges, the pronotum similarly colored, the margins of the black area less sharply defined as usual and extending nearly to the apical margin. Length 2.9–3.7 mm.; width 2.1–2.8 mm. Texas (Brownsville)."

The author adds "*bistripustulata* (= *erythrocephala*) is represented by *decora*." This description is apparently drawn from a limited series. In a large series the confluence of the anterior spots is very variable. Sometimes they form a perfect band, recalling *dentipes*. Sometimes they are completely separated as in specimens from Brownsville which it is difficult to separate otherwise from *decora*. This variety was apparently known to Mulsant who called it *var α*. See Fig. 85.

B. bistripustulata quichiana n. var.

The two transverse spots are large and connected by a narrow isthmus, the outer being extended anteriorly and broadly united with the humeral spot in both sexes. The subapical spot is also large, rounded on its inner face, angulate externally. See Fig. 84.

Length, 3.75 mm.

Habitat, Quiché, British Honduras.

Two specimens, male and female. The type is in the U. S. Nat. Museum, cotype in my own collection. The label states that it was found on corn and beans.

B. bistripustulata minor n. var.

In this variety the size is much reduced, the markings are entirely separate as in typical *bistripustulata*. It resembles *decora* Casey but *decora* is larger and the anterior spots are connected. It differs remarkably from the South American *bistripustulata* in size.

Length, 2.25 mm.

Habitat, Brownsville, Texas. (Chas. Schaeffer.)

B. bistripustulata obscura n. var.

Broadly oval; black above, reddish beneath with the head, sides of pronotum and marginal, discal and apical spots obscurely red and all connected. Beneath the insect is entirely reddish except the sterna. Punctuation above fine and close, surface dull. Head entirely red; pronotum with sides reddish for about one third the width, angulately within; epipleurae entirely reddish, marginal and discal spots equally in front of middle, obscurely connected; marginal spot also broadly connected with apical, leaving only a small semicircular black space on the margin behind the middle; apical spot large, oval, emarginate in front, reaching the side margin and approaching but not reaching the suture. Anterior tibiæ with a strong curved spine near the middle beyond which the outline is arched, nearly repeating the structure in *bistripustulata*. Male unknown. Fig. 80.

Length, 3.5 mm.

Habitat: Rincon Antonio, Mexico, one female collected by Frederick Knab. Type in U. S. Nat. Museum.

Inspection of males may necessitate, treating this as a species, but in their absence the characters seem to be so nearly those of *bistripustulata* as to indicate varietal rank.

Var. β. Mulsant is described as having the transverse spots confluent and connected with the subapical spot. This was not found in the material studied though some specimens approached it.

[*Note.*— *Coccinella erythrocephala* Fab. Ent. Syst., I, p. 289. Original description: "C. coleopteris atris: punctis rubris sex, capite thoracisque margine pallida rufescentibus. Habitat Kiliae. Corpus C. 6-punctulata multo minus, Caput, thoracis margo, pedesque pallida rufescentia. Elytra atra, nitida punctis tribus rubris 2.1. Abdomen nigrum."

The description in Mantissa Insectorum 1787 is identical.

Weise in D. E. Z., 1904, p. 361, says: "The application of this name to the Mexican *bistripustulata* should be rectified. Mulsant redescribed the typical ♂ in 1846 and recognized it as a European insect. Later Kraatz (B. E. Z., 1874) again called attention to this point. Crotch however followed neither Mulsant nor Kraatz. *Coccinella erythrocephala* Fab. = *Hyperaspis Fabricii Muls.* belongs to Oxynychus Lec. with simple claws, and is widely distributed in Siberia, Caucasus and Hungary but has not yet been found in Germany."

The locality "Kiliae" (Kiel) is probably an error.

Mulsant (Ann. Soc. Linn. Lyon, I, p. 198) makes *erythrocephala* a synonym of *bistripustulata* and says that, according to Dr. Schaum and the type at Kiel, it is not the insect which served as the type of his *Hyperaspis fabricii*.]

Group 2.

Abdomen of ♂ with third segment bicuspid at posterior margin, fifth segment excavated. In *bistripustulata* (Group 1) and its varieties the third segment is bicuspid; in *ursina* (Group 4) and allied species the fifth segment

is excavated; but it is only in the species of this group that both segments are modified in the same insect. Other supporting characters are: anterior tibiæ expanded at middle nearly as in first group, form broadly oval, subparallel at sides, less completely circular in outline; elytral markings in typical *dentipes* an interrupted fascia before the middle and a subapical spot, in the other species various modifications of these marks, as indicated below, which however never exceed three spots on each elytron and never duplicate the large rounded spots of the preceding group.

B. dentipes *Fabr.*

Systema Eleutheratorum, I, 1801, p. 381.— Oliv., 1808, p. 1051, t. 7, f. 110; Ency. meth., t. 6, p. 1051, 98, pl. 7, fig. 110.— Muls., 1851, p. 525.— Crotch, 1873, p. 378.— Gorham, 1899, p. 186, 1899.— Casey, 1899, p. 120.— Say, 1835, p. 202.

Original description: "C. coleoptris atris: fascia interrupta punctisque duobus rufis, tibiis anticis acute dentatis. Habitat in Carolina. Mus. D. Bosc. Maiuscula. Caput fulvum, margine postice atro. Thorax ater, nitidus, margine laterali late, antice tenuissime fulvo. Elytra atra, nitida: fascia media ad suturam abbreviata, punctoque postice fulvis. Pedes antici flavi, tibiis extus acute dentatis; postici flavi, femoribus nigris."

Length: 4.75 to 5.25 mm.

Habitat, including varieties: Ont., Ill., Va., N. C., Ga., Fla., La., Ky., Kan., Tex., Mex.; Gorham gives Jalapa, Atoyac and Chilpancingo in Mexico, and Temax in No. Yucatan.

The following varieties have been found:

socialis Casey, 1899, *l. c.* Kansas.
separata n. var. Va., Ill., Ind., Mo., N. C.
americana n. var. Costa Rica.

The strongest characteristic of *dentipes* is the form of the male abdomen, the third segment being more evidently bicuspid than in any other species while the fifth segment is as strongly excavate as in any species of the *ursina* group. This combination is found in all the forms I have treated as varieties of *dentipes* and plainly indicates their close relationship. In the other species of this group the combination is present but in a more feebly developed form and, in conjunction with the more divergent markings, indicates their more distant relation to *dentipes*.

The head is black with a small vertical pale spot in ♀ which becomes more extended in the ♂ and leads to an entirely pale head in var. *socialis* ♀. The thorax is black with the side margin entirely pale in ♀, the pale color extending angulately into the black disc. The pale color is more extended in the male and in the variety *socialis* leaves only an irregular basal black spot as shown in Fig. 24. The legs are flavous with the posterior femora darker.

The maculation of the elytra differs in the varieties as follows:

B. dentipes (typical form), Fig. 22, has a transverse band in front of the middle, interrupted at the suture and a subapical spot, red, as in the original description "fascia interrupta punctisque duobus" and "fascia media ad suturam abbreviata, punctoque postice fulvis."

Var. *socialis*, Figs. 23 ♀ and 24 ♂, has the transverse band much wider, a third as wide as the length of the elytra and the subapical spot very large.

Var. *separata*, Fig. 20, has the transverse band reduced to two small spots and the subapical spot very small.

Var. *americana* has the transverse band and subapical spot as in typical *dentipes* but the insect is very much reduced in size.

All the above are more oblong than *bistripustulata* and its varieties and differ, as described, in male characters and in maculation. Gorham says that the more oblong forms of this species pass insensibly into *bistripustulata* but by separating the specimens by the male characters this difficulty disappears as all the oblong specimens prove to be *dentipes*.

The range of this species extends much farther north than that of *bistripustulata* and less in the southerly direction, Costa Rica being apparently its southern limit. As *bistripustulata* shows a tendency to break into varieties at the northern and southern limits of its distribution, so this species also exhibits the variation called *separata* in the north and that called *americana* in the south; *socialis* appears to be confined to Kansas.

B. dentipes socialis *Casey.*

1899, Journ. N. Y. Ent. Soc., VII, p. 119.

Original description: "Elytra never conspicuously pale or maculate at base, each with two transversely confluent pale spots before the middle and a subapical spot, the spots very broadly confluent, forming a fascia slightly emarginate on both sides, the fascia a third as wide as the length of the elytra, broadening within, broadly truncate opposite the suture; subapical spot very large, extending along the limb, the marginal bead black; head in the female pale throughout, the pronotum very broadly and intero-angulately pale at the sides. Length 5.2 mm.; width 3.6 mm. Kansas."

The author adds: "The species from *socialis* to *dentipes*, probably including *tau* and *quadrillum*, which I have not examined, may be considered as subspecies of the *dentipes* type." Figs. 23 and 24. I have seen no female with the head pale throughout. The figures show specimens in my collection.

B. dentipes separata n. var.

Elongate oval, black, with the head partly or wholly, the sides of the thorax, and in ♂ the anterior margin also, and three elytral spots (one marginal, one discal

in front of the middle and one subapical) reddish yellow. This variety possesses all the structural characters of *B. dentipes* but differs in the reduction of the markings of the elytra to three small spots. Length; 4.25 mm.

Habitat: Virginia.

Type in my collection with which I associate other specimens from Ill., Ind., Mo. and N. C. Figs. 20 and 21.

B. dentipes americana n. var.

Elongate oval, sides subparallel, smaller and a little narrower than *B. dentipes*, the structure of which this insect reproduces on a reduced scale. Black with the head, the sides of the thorax (and the anterior margin also in ♂), a fascia in front of the middle of the elytra, broadly interrupted at the suture, and a subapical spot on each elytron reddish yellow.

Length: 3 mm.

Habitat: Pacayas, Costa Rica.

Described from a small series in the American Museum of Natural History. Fig. 86.

B. subfasciata *Muls.*

1851, Species, p. 527. Crotch, 1874, p. 211. Gorham, 1899, VII, p. 187.

The original description, abridged, is: "Obtusément ovalaire. Elytres noires, ornées chacune d'une bande d'un rouge jaune au d'un jaune rouge, couvrant du deuxième au quatrième cinquième environ du bord externe, transversalement étendue jusqu'au cinquième interne de la largeur.

"Patrie: le Mexique (collect. Dupont; Muséum de Paris)."

Length: 4.5 mm.

Additional localities: Nogales Ariz.; Texas; Cordoba, Mexico.

Each black elytron has an orange band extending from the outside margin for two thirds the width of the elytron. No subapical spot. The other characters are substantially those of *dentipes* and Gorham treats *subfasciata* as a color variety of *dentipes*. In the total absence of intergrades and in view of the different shape of the band and of other comparative differences this treatment does not seem to be entirely justified.

♂ Head pale. Prothorax black, margined in front and at sides with pale.

♀ Head black. Prothorax black, margined on each side with pale, sometimes missing. Figs. 30.

B. erythrura *Muls.*

1851, Spec., p. 530. Crotch, 1874, p. 211. Gorham, 1899, p. 187. (Fig. 29.)

Original description, abridged: "Obtusément ovalaire. Elytres noires, ornées postérieurement d'une bordure d'un rouge jaune, couvrant environ le quart de la longueur, mais graduellement détachée de la suture d'arrière en avant."

"Corps obtusément ovulaire ou presque en carré long et plus étroit en devant; convexe; pointillé; luisant, en dessus. Tête, antennes et palpes d'un rouge jaune ou d'un rouge orangé. Prothorax émoussé au-devant de l'ecusson; noir, parée de chaque coté d'une bordure d'un rouge orangé; la région noire, couvrant la moitié médiaire de la base, irrégulièrement rétrècie, nébuleuse et peu nettement limitée sur les cotès et en devant, atteignant à peine ou n'atteignant pas le bord antérieur. Elytres obliquement et obtusément tronquées chacune à l'extremité; noires, parées à leur partie postérieure d'une bordure d'un rouge orangé, de largeur uniforme, couvrant le dernier tiers du bord externe, égale au quart environ de la longueur du coté interne, graduellement détachée d'arrière en avant de la suture, dont elle reste distante du quart de la largeur à son angle antéro-interne. Dessous du corps noir sur les médi et postpectus, et sur les parties médiaires de l'antepectus et du premier arceau ventral, d'un rouge jaunatre ou testacé sur le reste. Pieds d'un rouge ferrugineux ou tirant sur le jaune."

Length: 3.6 to 4.2 mm.

In addition to the type locality (Mexico) it is found in Yucatan, Costa Rica, Guatemala, and Venezuela.

The black elytra are ornamented behind with an orange border, covering about one fourth of the length, but gradually detached in front of the suture, from which it remains distant a quarter of its width at its antero-internal angle. Fig. 29 represents a specimen doubtfully referred to this species, of which it has been difficult to obtain sufficient examples. The orange border covered by the original description is in the specimen figured only imperfectly developed. Beyond the maculation I know of nothing to differentiate this species which Gorham regards as a color variety of *dentipes*.

Head, antennæ and palpi are reddish yellow. The thorax is black with orange side margin, the black area being nebulously outlined and scarcely reaching the front margin. The pale head, entirely pale legs, apical spot of elytra reaching posterior margin will separate this species from *quadrillum* in which the head is black (with pale spot in ♂), the femora dark and the apical spot of elytra always distant from margin.

B. quadrillum *Lec.*

1858, Proc. Ac. Phil., p. 89. Crotch, 1873, p. 378; 1874, p. 211. Gorham, 1899, p. 186.

Original description: "Ovalis valde convexa, nigra nitida, dense punctulata, thorace macula magna laterali rotundata elytris, altera subreniformi subapicali flavo-rufis ornatis; antennis palpis pedibusque flavo-rufis, femoribus infuscatis."

Length: 5 mm.

Habitat: New Braunfels, Texas (type locality).

More regularly oval than *B. dentipes*; it differs from that species by the black head and by the anterior spots of the elytra being wanting, leaving

only a subapical orange red spot (Fig. 28). The other characters are similar to those of *dentipes*. There are no intergrading specimens known and no good reason appears for treating this name except as that of a valid species, unless it may prove to merge into *erythrura*, which was described in 1851 and would therefore have priority.

♂ Head with a pale spot, thorax with sides broadly pale, pale space angulate internally, anterior margin very narrowly pale, elytra sometimes with a minute humeral pale spot as well as the large subapical reddish spot. Ventral segments as in *dentipes* except that the cusps of the third segment are closer together.

♀ Head entirely black, thorax with sides less broadly pale, elytra never with humeral spot. For differences between this and *erythrura* see under that species.

B. blaisdelli *Nunn.*

1909, Ent. News, p. 132.

Original description: "Oblong, not very convex. Head, yellow in the ♂, black in the ♀ and with a large yellow spot placed vertically, shining, finely but thickly punctured with very shallow punctures. Thorax of ♂, black, slightly more heavily punctured than the head, a broad yellow patch laterally, and with front and side margins lined with a narrow pale or whitish yellow band. Thorax of ♀, black, punctured as in the male, with a broad yellow patch laterally but with light marginal band only found on the side margins and ending abruptly at the front angles. Elytra, black, shining, the punctures the same as on the thorax. Each elytron with a fascia and a sub-apical spot. The fascia is placed in front of the middle, is narrowest at its outer part where it touches the margin, but on the inner edge, is dilated into an irregular rounded blotch which does not quite reach the suture and which gives off a spur that runs parallel with the suture until it joins the sub-apical spot thus forming a sort of vitta. The confluence of the spur with the sub-apical spot is found in the ♀ but not in the ♂. Under side of thorax yellow; not strongly punctured; of body black; femur, dark; knees, tibia, and tarsi testaceous. L. .18 to .20 in inch.; w. .12 to .15."

Habitat: Goldfield, Nevada (type locality); Mesa Grande, Sonoma Co., Cal.; and Napa, Cal. Specimens from Willis, Texas, and from Arizona are, for the present, associated with this species.

In this species and in *tau*, while the characteristic form and sexual characters of *dentipes* are preserved in a but slightly modified form, the maculation, by more or less complete confluence of the pale spots, is greatly altered. In typical *blaisdelli* as shown in Fig. 31, drawn from a cotype kindly furnished by Mr. Nunnenmacher, the transverse band is very wide and connected with a humeral pale spot in front and with a very large subapical spot behind. In specimens from Arizona and Texas the pale color becomes even more extended thus approaching the next species.

B. tau *Lec.*

1859, Col. of Kansas, p. 28. Crotch, 1873, p. 378; 1874, p. 212. Gorham, 1899, p. 182.

Original description: "rotundato-ovalis, convexa, supra rufo-flava, nitida dense subtiliter punctulata, thorace basi subinfuscato, elytris fascia basali ad humerum, abbreviata, sutura anguste, guttisque utrinque duabus paulo pone medium nigris, margine externo pone maculas, apicalique nigro, subtus nigra, antennis, palpis, pleuris pedibusque flavis. Long. 19." [4.5 to 5.0 mm.]

One specimen, Fort Riley: John Xantus Esq. The head and sides of the thorax are paler than the rest of the upper surface."

Additional localities: Nebraska and Montana.

In this species, with the form of *dentipes* and similar sexual characters, are found the widest departure from the *dentipes* markings. In the male the head and thorax may be entirely pale except for a basal black spot on the latter; or in the male sometimes and in the female usually the yellow side margin of the thorax may cover one third its surface with an irregular internal margin; the head seems to be always entirely pale in the male. The elytra always have a broad black basal fascia connected with a black sutural stripe, the remainder of the elytra yellow immaculate or enclosing a discal and a post median lateral black spot. In the specimens examined there is much individual variation but all agree in the complete confluence of the markings so that the elytra are more yellow than black.

Group 3.

This group contains a few Mexican species in which the third segment beneath in the male is bicuspid somewhat as in the first group. The species of this group are smaller, the maculation is of an entirely different pattern and the front tibia is simple beyond the tooth. The four species included are very similar except in maculation. This is known to be variable throughout the Coccinellidæ and the series in Dr. Fenyés' collection of the species of this group shows it to be especially so here. The probability of further collections completely uniting them is great, but the material at present available is insufficient. I have therefore retained as distinct species the following, to be separated as indicated in the Synopsis.

B. westwoodii *Muls.*

1851, Species des Coléoptères Trimères Sécuripalpes, p. 520. Crotch, 1874, p. 211. Gorham, 1899, p. 185, pl. X, fig. 17.

bipartita ♀ Muls., l. c., p. 521.

The original description, in part, gives the following characters: Obtusely oval,

elytra orange red, with sutural and marginal border, black. The sutural feebly expanded at about one quarter, the marginal covering scarcely more than the epipleuræ becomes wider behind. Body beneath black, tibiæ and tarsi yellow.

Head ♂ orange red, labrum darker, ♀ black; thorax ♂ orange red, paler at sides, with a basal black blotch covering two thirds of the base, feebly rounded in front; ♀, black with only the anterior angles pale. (Fig. 69.)

Length: 3.6 to 5.0 mm.

Habitat: Mexico (type locality), Vera Cruz, Guanajuata (Gorham).

B. bipartita ♀ Muls., l. c., p. 521 is regarded by Gorham as a synonym of *westwoodii* ♂. Mulsant's description is almost identical with his description of *westwoodii* except as to length, which he gives as 3.6 mm. for *bipartita* and 5.0 mm. for *westwoodii*: "Brièvement ovales. Elytres d'un rouge jaune, parées d'une bordure suturale et d'une périphérique, noires, ne couvrant que le rebord, un peu moins étroites a l'angle sutural. Patrie: le Mexique (collect. Chevrolat, Dejean)."

The differences he gives in the more minute description are those which commonly mark the sexes in this genus.

B. conjuncta *Muls.*

1851. Species des Coléop. Trim. Sécuri., p. 536. Crotch, 1874, p. 212. Gorham, 1899, p. 188, fig. 20, plate X.

From original description: "Ovale. Elytres noires, parées chacune de cinq taches jaunes: deux, couvrant toute la base et forment postérieurement une bordure bifestonnée: deux, en rangée transversale vers la moitié de la longeur: l'interne, orbiculaire, voisine de la suture: l'externe, semi-orbiculaire, liée au rebord externe: la cinquième, en ovale transversal, subapicale."

"♂ Tête flave. Prothorax paré en devant d'une bordure flave, étroite et un peu inégale. Epimères du médipectus et pieds, flaves. ♀ Tête jaune avec l'épistome et parfois la partie inférieure du front, noirs ou obscurs. Prothorax sans bordure flave en devant. Epimères du médipectus, noires. Pieds d'un flave rouge, avec la majeure partie des cuisses, à compter de leur base, noire."

Length: 3.5 mm.

Habitat: Mexico (type locality), Costa Rica (Gorham).

This species differs from the preceding in the elytral markings which comprise five black spots, two covering the entire base and forming a festooned border behind; two about the middle of the elytra, the inner orbicular near the suture, the outer semi-orbicular united with the narrow black margin observed in *westwoodii*; the fifth oval, subapical. The spots may be increased in size as shown in Figure 72 (copied from Gorham) and an equivalent reduction would make a form identical with *westwoodii*. No such reduction has been observed, but the variations found in a series of *aymardi* suggest the possibility of its being discovered. Gorham compares this species with *pygidialis* but does not describe the ♂ characters. Mulsant places it between *pygidialis* and *confusa* (= *4-punctata*).

B. aymardi *Gorham.*

1899, Biologia Cent. Amer., VII, p. 186, pl. x, fig. 18.

Original description: "Nigra; capitis fronte maculisque duabus magnis transversis ad angules anticos prothoracis flavis; elytris rufis, sutura tenuiter, macula communi suturali juxta basin, et duabus alteris discoidalibus, una subhumerali, una majore subapicali, nigris. Long. 4.5 mm. ♀. Hab. Mexico, Parada (Sallé)."

It has also been found at Atlixco, Mex., June (Fenyes).

Gorham says further that it is "clearly allied to *B. westwoodii* but larger than that species and differs, moreover, in the large yellow mark on the anterior angles of the thorax. This mark occupies the whole angle, and extends along the side almost to the base, it is prolonged obliquely into the disc, leaving the front margin black. The body beneath is black, the tibiæ and tarsi yellow." The difference in size is not important, especially as Mulsant gives 5.0 mm. as the length of *westwoodii.* The color of the thorax, which Gorham described from the ♀ varies in the sexes and individually. Figures 65 ♂ and 64, 66 and 67 ♀♀ show the variations observed in the series from Atlixco in the Fenyes collection. I have retained *aymardi* as distinct on account of its elytral maculation, consisting of narrow sutural border, joined to a common sutural spot near the base and two or three other discal spots, one subhumeral and one or two subapical, not being exactly duplicated in any other species, but I suspect that larger series may unite this also with *westwoodii.*

B. cryptocephalina *Gorham.*

1899, Biologia Cent. Amer., VII, p. 186, pl. x, fig. 19.

Original description: "Nigra; elytris sanguineis, sutura tenuiter, punctisque tribus nigris, uno subhumerali, duobus pone medium transversim approximatis, nigris Long. vix 6 mm. ♀ Hab. Mexico, Ventanas in Durango (Höge)."

Gorham adds: "Entirely black, with the exception of the elytra, which are of a rich blood-red colour, with the suture (narrowly at the base, more widely at the apex), and three small spots on each, black. This fine species cannot be confounded with *B. aymardi,* as it is larger, the head and thorax are wholly black, and the elytral markings are different. The single specimen obtained by Höge is the only one I have seen. It is apparently a female." The elytral markings he describes as narrow sutural border and three spots black, one subhumeral, two behind the middle transversely approximate. I have retained this also as distinct in the absence of intergrading specimens but, in view of its being described from a single female and its validity resting upon size, entirely black thorax and absence of the common sutural spot of *aymardi,* I expect it may ultimately be united with that insect. Fig. 71.

Group 4.

This group contains a large number of species in which the fifth segment of the abdomen ♂ is excavated while the third segment is simple or nearly so. The anterior tibia is toothed as usual and in addition is swollen or feebly toothed at apex. The maculation is variable but may be considered as including five pale spots on each elytron, modified in some species by disappearance or confluence of certain spots. Four sections are indicated by these variations in maculation and supported by minor differences in structure, viz:

1, Five pale spots distinctly limited;
2, Five pale spots indistinctly outlined or partly or wholly confluent, leading in extreme cases to pale elytra;
3, Five pale spots reduced in size as an unusual form or one or more lacking as a usual form, leading to forms in which only two of the five spots remain; and
4, Confluence so complete as to leave pale elytra with irregular black markings.

The first form may be regarded as the typical form in this group. It is shown in *ursina.*

The second form retains the broadly oval form of *ursina* but it is accompanied by the greatest development of the apical supplementary tooth of the anterior tibia.

The third form is exhibited in several species of diverse form some being decided more elongate than *ursina.* The material here included is not as homogeneous as elsewhere.

The fourth form is exhibited by *albifrons* and allied species. The body is more elongate than in *ursina* and the excavation of the 5th segment ♂ reaches its maximum.

The distribution of the species of this group is entirely Mexican and northward except *propria,* described from Peru, which is incorporated unseen from the description of Kirsch, and *australe* from Paraguay and Brazil. The species of the first section occur all over the U. S. except the Pacific slope and in Mexico, exhibiting slight but fixed modifications in maculation in the different regions into which they penetrate. The species of the second section are confined to the warmer southwestern regions and are remarkable for the great amount of individual variation they exhibit. The third section contains two heterogeneous elements, the one exemplified in *mexicana* and *fenyesi* confined to the lower Sonoran region, the other represented by *4-punctata* and *indubitabilis* distributed in the northeastern parts of the United States and Canada. The fourth section comprising *albifrons, illustris* and *pacifica* is especially developed in the region, immediately east of the Rocky Mts. *Pacifica* is unknown outside of the Casey

collection and it is possible that the locality label (Sta. Monica, Cal.) is erroneous. It seems to be unknown to all the California collectors with whom I have corresponded.

B. ursina *Fab.*

1787, Mantissa Insectorum, p. 61; 1792, I, p. 291. Mulsant, 1851, p. 532. Crotch, 1873, p. 378; 1874, p. 211. Gorham, 1899. Casey, 1899, p. 120.

bisquinquepustulata Oliv., 1808, Ent., VI, p. 1053.

Original description: "C. coleopteris atris; punctis decem albis, capite thoracisque margine antice albis. Habitat America boreali Mus. D. Hunter. Parva, nitida. Caput album oculis nigris. Thorax ater, nitidus margine antice sinuato albo. Elytra atra punctis quinque albis 2, 2, 1. Corpus nigrum pedibus albis."

Length: 2.0 to 3.6 mm., the males in this species being often much smaller than the females.

Habitat: Northeastern United States and Northern Mexico. The localities represented in the abundant material examined include Manitoba, Mass., Conn., N. Y., N. J., Pa., Va., N. C., S. C., Fla., O., Ky., Ill., Mich., Wis., Neb., Colo., Ks., N. Mex., and Mexico. Gorham gives also Lake Superior and Texas in U. S.; and Cuidad and Ventura in Durango, Mexico.

The following varieties have been described.

stellata Casey, *l. c.*, p. 117. Ill., Mo., Ky.
congruens Casey, *l. c.*, p. 117. N. C., Northern Ga.
uteella Casey, Can. Ent., XL, p. 413. Utah.
sonorana Casey, Can. Ent., XL, p. 412. Durango, Ariz., N. Mex.

The variety *stellata* seems to be confined to the Middle West, the variety *congruens* to the mountains of North Carolina and Georgia, and the varieties *uteella* and *sonorana*, which are not very distinct, to the Sonoran region.

This species from its wide distribution in the most settled parts of our country is well known to all collectors. It is difficult to separate from *felina* (= *10-pustulata* Mels.) but if the sexes are separated first the difficulty will in great part disappear. The males have the fifth ventral segment plainly excavated and have more pale color on the head thorax and humerus. When the sexes are separated it will be found that the smallest males of *ursina* are as large as the largest females of *felina*, while the males of *felina* are much smaller still. Comparing sex with sex *ursina* is considerably the larger insect. Specimens will be found that are very close in markings but usually the basal spots are more rounded in *ursina*, more elongate transversely in *felina*. The apex of the elytra is more sinuate in *felina*. Mulsant regarded these small specimens as small *ursina*. He did not recognize the description of *felina* and did not know that Melsheimer was describing *10-pustulata* while he was finishing his monograph, so that in his work no separate mention occurs of the smaller species. Crotch and Casey

both treat the two as distinct. I am led to follow their course not only because of the constant difference in size but because the excavation of the ♂ fifth abdominal segment seems stronger in *felina* than in *ursina* instead of weaker, as it should be in proportion to the reduced size were they identical.

The varieties described by Casey are separated as indicated in the synoptic table. Copies of his descriptions will be found below. The markings of *ursina* ♂ are shown in Fig. 33, ♀ in Fig. 32; of *stellata* in Fig. 34, of *congruens* in Fig. 35, of *uteella* in Fig. 36.

B. ursina stellata *Casey.*

Original description: "Elytra pale at base, or each with a pale spot near the middle of the basal margin; elytra each with five clearly defined and isolated pale spots, two basal, two in a transverse line very near the middle and one subapical, the humeral constant in both sexes; elytral spots generally separated from each other by more than their own dimensions; basal spot almost fully circular, only slightly truncated by the basal margin; body small, elongate-oval, piceous brown in color; head and subquadrate sides of the pronotum flavate in the female; elytra finely but strongly, sparsely punctate, polished, the spots nearly equal, moderately large, the subapical largest and the humeral smallest; under surface piceous; legs pale throughout. Length 1.9–2.1 mm.; width 1.3–1.45 mm. Indiana."

"The species from *stellata* to *bolli* are more or less close derivatives of the *ursina* type."

B. ursina congruens *Casey.*

Original description: "basal spot never much more than semi-circular broadly truncated by the basal margin; male with the two median lobes broadly and rectilinearly truncate, the dividing spur of the apical pale margin short and very minute or obsolete, body more broadly oval than in *ursina* and more variable in size, finely punctate; spots small, variable in size and form among themselves, the subapical usually the more conspicuous. Length 2.1–3.6 mm.; width 1.6–2.75 mm. North Carolina (Asheville)."

Congruens is one of the names included in the author's sentence, "The species from *stellata* to *bolli* are more or less close derivatives of the *ursina* type."

B. ursina uteella *Casey.*

Original description: "The following species is allied to *ursina*. Form elongate-oval, very convex, polished, minutely, rather sparsely punctate, black; female with yellow spots as in *ursina*, and nearly as large, except that the two medial are relatively more distant from the two basal, so that, instead of forming a square as in *ursina*, they form a slightly elongate rectangle; pale side margin of the prothorax much less broadly dilated anteriorly. Length 3.6 mm.; width, 2.3 mm. Utah (Milford) Wickham."

Specimens lately received from Mr. Norman Criddle indicate that this variety, which Mr. Criddle found in Manitoba, may occur throughout the region immediately east of the Rocky Mountains.

B. ursina sonorana *Casey.*

Original description: "A subspecies of *uteella* may be defined as follows: Form still narrower than in *uteella*, ellipsoidal, polished, black, very minutely, decidedly sparsely punctulate; female with spots nearly as in *uteella* but much smaller, except that the rectangle formed by the basal and slightly post-medial spots is still more elongated and the humeral spot is reduced to a small dot; the basal spots differ in being very small, nubilous and wholly detached from the margin. Length, 3.0 mm.; width, 2.0 mm. Mexico (Colonia Garcia, Chihuahua), Townsend."

The author adds: "I have not examined the males in either of these forms, which differ profoundly from *ursina* in their narrower, more elongate outline, and more especially, in the very fine and sparser punctures."

B. octostigma *Muls.*

1851, Species des Coléop. Trim. Sécuri, p. 539. Crotch, 1874, p. 212. Gorham 1899, VII, p. 188.

Original description: "Ovale. Elytres noires, parées chacune de quatre taches subarrondies, assez grosses, d'un jaune flave; trois, presque également très-rapprochées de la suture; la postérieure de celle-ci, apicale: une, liée au rebord externe, du quart à la moitié de la longueur, en quinconce avec les deux juxta-suturales antérieures."

"♂ Tête flave. Prothorax noir, paré en devant et sur les côtés d'une bordure d'un jaune pâle; la region noire, couvrant les deux tiers médiaires de la base, bidentée en devant, c'est-à dire obliquement avancée du sixième externe de la base jusqu'au cinquième antérieure, vers la partie correspondante au bord interne des yeux, entaillée sur la ligne médiane jusqu'à la moitié de la longueur. Elytres ornées ordinairement d'une petite tache flave, obtriangulaire, humérale. Epimères du médipectus et pieds, flaves."

"♀ Tête jaune ou d'un jaune flave, avec l'épistome et parfois la partie inférieure du front, noiratres ou obscurs. Prothorax noir, paré de chaque côté d'une bordure flave, étendue en devant jusqu'à la sinuosité postoculaire, couvrant le sixième externe de la base, curvilinéairement ou anguleusement dilatée au côté interne. Epimères du médipectus, noires. Elytres non parées d'une tache flave humérale. Pieds jaunes; cuisses d'un jaune rougeâtre."

Length: 3.0 mm.

Habitat: Mexico (type locality) Chiriqui, Mexico, Guatemala and Panama (Gorham).

This species is similar to *testudo* Casey in its rounded outline, shining surface and large spots but differs in the humeral spot being absent in ♀ and very small ♂ and in the marginal spot being nearer the base, about half way between the basal and discal spots instead of being nearly parallel with the latter as in *testudo*. Fig. 44.

B. testudo *Casey.*

1899, Jour. N. Y. Ent. Soc., VII, p. 118.

Original description: "Elytra each with five clearly defined and isolated pale spots, two basal, two in a transverse line very near the middle and one subapical, the humeral constant in both sexes; spots relatively larger, whitish, separated by their own diameter or less; form elliptical, the spots, excepting the humeral, subequal in width and isolated at about their own diameter or a little less; head and subquadrate side spot of the pronotum pale in the female, the surface finely rather closely punctate and fully three-fourths longer along the median line than at the sides; elytra finely, sparsely punctate, piceous-black; legs pale. Length 2.7 mm.; width 2.0 mm. Texas (Brownsville)."

This, according to the author, is a "more or less close derivative of the *ursina* type." It is smaller, more shining and with more rounded, clearly defined pale spots than *ursina.* By the descriptions it seems to be very close to *octostigma* but I have retained it as distinct because of the presence of the humeral spot, which is lacking in the Mexican species and the different position of the marginal spot. As shown by the figures these differences make *testudo* an easily distinguished species. Fig. 45.

B. felina *Fab.*

1775, Syst. Ent., p. 87; 1787, I, p. 61; 1792, I, p. 290.

Original description: "C. coleopteris atris; punctis sex albis corpore globoso."

Entomologica System. I, p. 290, 1792 felina. 113. C. coleopteris atris: punctis sex albis, corpore globoso. Habitat in America boreali Dom. Drury. Parva, tota globosa. Caput album, immaculatum. Thorax albus macula baseos nigra. Elytra atra punctis tribus lineolaque parva baseos albis."

Length, 1.5 to 2.0 mm. = .06 to .08 inch.

Habitat: Amer. bor. (type locality) Mass., Vermont, N. Y., N. J., Penn., Md., D. C., Va., N. C., Mich., Ky., Ill., W. Va., Neb., Mo., La., Texas.

The description of Fabricius covers a form of this species which is unusual in collections and caused Mulsant and Crotch to pass the name as unrecognized. It calls for elytra black with three small spots white *and a small basal white line.* This line results from the usual basal spot being transversely elongate as in many specimens from the mountains of N. C. Most of the specimens in collections belong to Melsheimer's variety *10-pustulata.*

For the differences between this species and *ursina* see under that species. *Fulvopustulata* Mels., lacking the humeral spot, is not exactly represented by any specimen I have seen. Its description is here copied for comparison when necessary.

Proc. Ac. Nat. Sci., Phila., III, 1847, p. 178. "Deep black above; front, lateral margins of the thorax, and four spots on each elytron, fulvous; tibiæ and tarsi testaceous.

"1 l. long. Pennsylvania.

"Deep black, shining, densely and very minutely punctured: head with a large yellowish or fulvous frontal spot; labrum and antennæ, testaceous: thorax with a

large whitish spot on each of the lateral margins, contracted on the posterior angles: elytra, each with four pale fulvous spots, placed 1.2.1; anterior spot occupies the inner basal angle; posterior one is placed a little before the apex, nearly equidistant from the suture and the lateral edge; beneath and femora, dull ferruginous: tibiæ, tarsi, and apex of the femora testaceous; tooth of the anterior tibiæ, small. Resembles somewhat *ursina* Fab. but is smaller than that species, and differs in the elytral spots."

It has been treated heretofore as a synonym and the absence of any specimens in the extensive material studied leads me to suppose it to be based on an accidental or apparent absence of one of the usual spots and follow previous authors in treating it as a synonym.

The following variety is the form commonly found in collections:

B. felina 10-pustulata *Melsh.*

Proc. Ac. Nat. Sci., Phila., III, 1847, p. 179.

Original description: "Black; head, lateral thoracic margins and ten elytral spots fulvous; feet testaceous yellow. ¾ l. long. Pennsylvania.

"Shining black: head indistinctly punctulate, yellowish-fulvous: eyes black; antennæ, palpi and feet yellowish: thorax punctured like the head, with the lateral margins fulvous; scutellum comparatively large: elytra distinctly and densely punctulate, each with five roundish fulvous spots, placed 2, 2, 1; the terminal spot is confluent with the apical edge: beneath black; pleuræ and epipleuræ testaceous yellow. Var. A. As in the type, with the head and thorax entirely black."

B. propria *Kirsch.*

1876, Deutsche Ento. Zeits., XX, p. 119.

According to the author it is shortly oval, black beneath, yellow above, head yellow ♂, black ♀ with a vertical yellow spot; prothorax male with a basal black spot, quadridentate in front, female black yellow at sides; elytra black with five yellow spots, the first juxta-scutellar, the second humeral, triangular, the third rounded behind the middle, the fourth semiorbicular at the middle of the side margin, the fifth large transverse and subapical. Similar to *ursina* but differs in the position of the third and fourth spots, the former standing behind the middle, near the suture, the latter at the middle of the side margin, often confluent with the triangular humeral spot.

Length: 2.0 to 3.0 mm. = .08 to .12 inch.

Habitat: Peru.

I have not seen this species and it is placed in Group 4 on account of the similarity of the markings and the comparison with *ursina* made by the author.

B. australe n. sp.

Closely allied to *B. ursina* but smaller, more circular in outline, more convex, more shining and finely punctulate; and with the humeral spot of the elytra extending along the side margin.

Head black ♂ ♀; thorax black ♂ with the sides and narrow front margin yellow, the black area arcuately limited in front without any indentation, black also ♀ with the front angles yellow; elytra black with five yellow spots, one basal, juxtascutellar, semicircular, one humeral running down the side margin, arcuately limited within, one at the middle of side margin, circular, one slightly behind it, behind the middle, near the suture, oval, one subapical, slightly transverse, all further apart than their own diameter. Underside black, legs fusco-testaceous. ♂ with fifth segment excavate at middle of posterior margin.

Length: 2.0–2.75 mm.

Habitat: San Bernardino, Paraguay, Oct. 1, Bonito Prov. Pernambuco, Brazil, Jan. 17, where it was collected on cotton. Described from 2♂, 3 ♀, types in Nat'l Museum.

B. bollii *Crotch.*

1873. Trans. Amer. Ent. Soc., p. 379. Gorham, 1899, p. 188, Casey, 1899, p. 118.

Original description: "♂ Convex, rounded sub-globose, black, shining, legs and head yellow; thorax broadly yellow in front and on the sides (the black color bilobed in front); elytra feebly punctate, each with five ill-defined yellow spots (two basal, two medial, one sub-apical, free); the two basal ones are partially confluent as are also the two marginal ones. L. .10 inch. Var.— Spots suffused. Dallas, Texas."

It is found also at Vowell's Mills, La.

This species is subject to individual variation by which the two basal spots become confluent, on the two marginal spots, or in extreme cases, all the spots, leading to pale elytra with a sutural dark design as shown in Fig. 43.

♂ head pale; thorax pale with a black basal mark covering nearly all the base and extending over about half the surface, bisinuately outlined in front.

♀ head pale; thorax black with pale side margins.

The abdominal characters of *ursina* are practically reproduced in this species. Figs. 42 and 43.

B. arizonica *Schffr.*

1908, Jour. N. Y. Ent. Soc., XVI, p. 125.

Original description: "Slightly smaller and more rounded than *ursina*, similarly marked, but without median spot on lateral margin and with basal spots always confluent. Head pale in the male; pale at middle, black at apical margin and infuscate at sides in the female. Thorax black, apical margin and a large triangular spot at sides pale in the male, in the female the apical margin very narrowly and a narrow subtriangular spot at apex, which extends slightly below middle, pale. Elytra black, two basal spots on each side, large and always broadly confluent, a large rounded, discal spot near suture and large apical spot nearer the margin than suture yellowish or reddish. Punctuation of thorax and elytra as in *ursina*. Under side of body black; legs pale in the male; femora piceous, tibiæ and tarsi pale in the female.

Anterior tibiæ with the usual tooth near base, and in addition a smaller, but more obtuse one near apex. Abdomen in the male as in *ursina*, but the fifth and sixth segments more depressed.

"Huachuca Mts., Arizona."

"This species varies a good deal in the extent of the elytral spots. All the spots may unite more or less and gradually extend over the entire surface, leaving only the suture and apex broadly, the side margin narrowly and a spot on the humeral callus black. This species differs principally from *ursina* and *testudo* by the very large and always broadly confluent basal spots, the absence of the median marginal spot on each elytron, the bidentate anterior tibiæ, and in addition from *ursina* by the shorter and more rounded form."

Length: 2.5 to 3.0 mm.

Additional localities are: Chiric. Mts., Arizona (U. S. Nat. Museum); and Matamoras and Cuernavaca, Mexico.

In this species the usual five spots occur on the elytra, the basal spots usually confluent, the marginal spot often broken into two small spots or lacking. The spots are more clearly defined than in *bollii* and there is less tendency to complete confluence which does nevertheless occur as shown in Fig. 41. There is much individual variation as in the preceding and as shown in Figs. 37 to 41, but the form of the anterior tibia with its additional apical tooth is a constant character separating this species.

B. indubitabilis *Crotch.*

1873, Trans. Amer. Ent. Soc., p. 379, Casey, 1899, p. 120.

Original description: "Very close to *B. ursina* in size and coloring, the punctuation is finer and the elytra have no trace of the two basal spots; the two medial spots are distinctly before the middle and not on it as in *B. ursina*; the posterior spot is small. L. .12 inch [usually smaller]. ♂ head, sides (broadly) and front margin of thorax yellow, a sharp yellow tooth projects from the centre of the margin. ♀ head black, with an obsolete orange spot. Illinois."

Other localities: Mich., Penn., N. J., N. Y., Md., D. C. and Iowa.

This species is comparatively rare in collections and doubtless occurs in other parts of northeastern U. S. for which I have no records. This species resembles *ursina* in form and markings and the male has similar modification of the ventral segments though more feeble. It differs superficially in the smaller size, finer punctuation and in the reduced size of the spots and structurally in the long and slender tooth of the anterior tibia. Crotch in his original description says the two basal spots are always missing, the two medial spots are in front of the middle and the subapical spot is small. Some variation has been observed in maculation and the characteristic features of the species seem to rest rather on the form of the tooth of the anterior tibia than on the always reduced maculation. Fig. 56 ♂; 57 ♀.

B. fenyesi n. sp.

Broadly oval, black above and beneath with the head, sides of pronotum, humeral, marginal, discal and subapical spots red. In the male, the anterior margin of pronotum is also red. Beneath, the antennæ, anterior tibiæ and all the tarsi are reddish. Head pale in both sexes, slightly infuscate before the labrum, finely punctate; pronotum black, finely punctate, shining, ♀ sides red as far as the eye in front, red space growing narrower posteriorly and ending just before the hind angle, ♂ with the red sides joined by a narrow anterior marginal border; elytra black, finely distantly punctate, shining with four red spots, viz: humeral, small ♀ larger ♂, small marginal just before the middle, larger discal just behind the middle, and subapical, all bright red. Anterior tibiæ with tooth in usual position but small, tibiæ beyond the tooth simple. Sexual modification of ♂ abdomen confined to 5th segment which is deeply emarginate and depressed. (Fig. 88.)

Length: 3 mm.

Colorado (Muckanawago, Gunnison and Glenwood Springs, July).

Dedicated to Dr. A. Fenyés of Pasadena, Cal., in recognition of many favors.

B. mexicana n. sp.

Broadly oval, black above and beneath with the head, broad side margin of pronotum, humeral, marginal, discal and subapical spots of elytra yellow. Beneath the tibiæ tarsi and mouth parts are also yellow. In the male the head is entirely pale and the anterior margin of pronotum is pale; in the female there is only a pale spot on the head and the pronotum is black except for the pale side margins. Head finely closely punctate, pronotum and elytra finely more distantly punctate. Humeral spot of elytra moderate ♂, very small ♀, marginal spot in front of the middle, discal spot elongate in front of the middle and in front of the marginal spot, subapical spot large equally, distant from margin and suture. Anterior tibiæ with the usual spine but not prominent and closer to the base than usual. Abdomen ♂ with 5th segment simply emarginate and flattened at middle; 3d and 4th segments also slightly flattened. Fig. 89.

Length: 3 mm.

Habitat: Santa Fé, Mexico collected by R. H. Hay, Nov. 7. Type ♂ in Nat. Museum. With which I associate two females from Atlixco, Mexico (May) in which the discal spot is less elongate.

B. 4-punctata *Mels.*

1847, Proc. Ac. Nat. Sci. Phila., III, p. 178.

basalis ♂ Mels., *l. c.*, p. 179; Crotch, 1873, p. 378; 1874, p. 212; Casey, 1899, p. 118;

diversa Muls., *l. c.*, p. 538.

Broadly rounded, polished, rather sparsely punctulate. Male with the head pale, the prothorax pale with a basal black area extending to lateral eighth, approximately bilobed in the middle, extending to apical fourth or fifth or all black except narrow anterior border; female with the head black, the front sometimes nubilously

pale in V-shaped design, the thorax black throughout, except a very narrow margin about the apical angles. Maculation of the elytra variable as follows:

Basal and subapical spot, Fig. 52, *4-punctata* ♀.

Humeral and basal spots not connected, subapical spot (*basalis*), fig. 55, *4-punctata* ♂.

(*diversa* ♂ ♀ synonymous with above).

Humeral and basal spots connected or nearly connected, subapical, Fig. 54, *confusa* ♂.

(In *confusa* ♀ the humeral spot is small).

Humeral, basal, marginal and subapical spots, and sometimes even a minute discal spot, fig. 53, *flavifrons*.

Length, 2.2 to 3.5 mm.

Habitat, Atlantic States, Canada and Massachusetts to Florida and inland to Illinois.

By the elytral maculation alone, the last variety would link this species with *ursina*. Besides the more rounded form and polished surface there is a constant difference in the form of the ♂ abdominal segments. While the group character, the excavation of the fifth segment, is preserved it is in a much more feeble condition and this species therefore approaches those of the last group in that respect.

There is not a little individual variation in color in the varieties cited and the reader must expect some specimens that will not fall precisely within either description.

The distribution of this species, as far as known, extends from Mass. (Canada according to Wickham) southward to Fla. and through Miss. and La. and in Pa., W. Va., Ohio, Ky., and Ill. It seems to be abundant in the southern Atlantic States.

Its variations are sufficiently indicated in the synoptic table and in the original descriptions given below. Its strong characteristic is the repetition of the structural characters of *ursina* with the disappearance of the discal and other spots more or less completely evident. Rarely in var. *flavifrons* even the discal spot is faintly represented.

The male of *4-punctata* was called *basalis* by Melsheimer. (Proc. Ac. Nat. Sci. Phila., III, p. 179) and described as follows:

"Head, anterior and lateral margins of the thorax, four basal and two apical spots of the elytra, pale sulphureous: two thoracic spots, elytra and beneath, black.

"1½ l. long. Pennsylvania.

"Hemispheric, very minutely punctured, shining: head pale sulphureous: eyes similarly colored, with a dusky pupil, antennæ and feet color of the head: thorax color of the head, with two large subtriangular black basal spots, separated by a narrow dorsal line: elytra black, each with three large pale sulphureous spots, of which two are at base and one at apex: the inner basal spot is much larger than the humeral one; the apical spot is suborbiculate, and is placed nearer the edge than the suture; beneath blackish. Perhaps a variety of *felina* Fab."

The name he applied on page 178 (*4-punctata*) takes precedence of that on page 179. The following is his description of *4-punctata* taken from the female:

"Deep black; elytra with four fulvous spots; tibiæ and tarsi dull testaceous $1\frac{2}{3}$ l. long. Pennsylvania.

"Deep black, shining, finely and densely punctured: head immaculate: antennæ dull testaceous: thorax immaculate: anterior angles obscurely piceous: scutellum triangular: elytra, each with a subrotund spot at base on the inner angle, and another similarly shaped and sized one a little before the apex, and nearer to it than to the suture, fulvous: beneath and femora, black: knees, tibiæ and tarsi, dull or dusky testaceous: prickle of the anterior tibiæ robust, prominent."

Mulsant described ♂ and ♀ under the name *diversa* and exactly reproduced Melsheimer's *basalis* and *4-punctata*. The following is a copy of the essential part of his description:

"Brievement ovale. Elytres noires, parées chacune de deux taches d'un rouge orangé: la première, presque subcordiforme, couvrant les trois cinquièmes internes de la base, prolongée en se rétrécissant jusqu'au quart de la longueur: la deuxième suborbiculaire, subapicale, liée au rebord de la courbure postéro-externe, étendue jusqu'au tiers interne. Long 0^m, 0036 ($1\frac{2}{3}$ l.).— Larg. 0^m, 0029 ($1\frac{1}{3}$ l.). Patrie: l'Amérique du nord. (Collect. Dejean type.)

"♂ Tête flave. Prothorax noir, paré de chaque côté d'une bordure flave, étendue en devant jusqu'à la sinuosité postoculaire, d'une largeur égale jusqu'au quart de la longueur, brusquement rétrécie de moitié dans ce point, et graduellement de là à l'angle postérieur; orné en devant d'une bordure également flave, assez étroite, liée par ses extrémités à chacune des bordures latérales. Elytres notées d'une petite tache humérale, flave, obtriangulaire. Epimères du médipectus, flaves. Pieds d'un flave roussâtre: cuisses intermédiaires en partie nébuleuses ou noirâtres: cuisses postérieures presque entièrement noires ou noirâtres.

"♀ Tête noire, marquée de quelques petites taches d'un jaune rougeâtre. Prothorax noir, paré aux angles de devant d'une bordure d'un jaune roussâtre, très étroite, étendue jusqu'à la sinuosité postoculaire d'une part, et jusqu'aux deux tiers des bords latéraux, de l'autre. Elytres sans tache humérale. Dessous du corps entièrement noir. Cuisses noires. Jambes et tarses d'un roux jaunâtre ou d'un rouge flave: jambes postérieures en partie obscures. Obs. Quelquefois la tête et le prothorax sont entièrement noirs."

It will be noted that these descriptions practically cover the two sexes described by Melsheimer as *basalis* and *4-punctata*, his work being unknown to Mulsant, whose preface is dated Dec. 29, 1848, though his book was not published until 1851. Casey is, I think, clearly in error in citing *diversa* as ♀ of *4-punctata* and *confusa* as ♂ of the same species. I have shown that Mulsant described *both sexes* of *diversa* and the same is true of *confusa* which is actually a variety in which the female has a small humeral spot and the male has the two basal spots much extended and even sometimes united as described below.

It is true that Mulsant in a later paper (1856) says that *basalis* Mels. is to be used in place of *confusa* Muls., and *4-punctata* Mels. in place of *diversa* Muls.; but, as far as the name *confusa* is concerned, this is simply a mistake on the part of Mulsant and, for the variety called *confusa* in this paper, no other name can be used except that first given to this variety in question in 1851.

B. 4-punctata confusa *Muls.*

1851, Species Trimeres Securipalpes, p. 537.

"Ovale. Elytres noires, parées chacune de trois taches jaunes: les première et deuxième, presque liées à la base: l'interne, semi-orbiculaire, couvrant les deux tiers de la largeur, prolongée jusqu'au cinquième de la longueur: l'interne plus petite, humérale: la troisième, suborbiculaire, subapicale, étendue du quart interne presque jusqu'à la courbure postéro-externe.

"Long 0^m, 0022 à 0^m, 0036 (1 à $1\frac{1}{2}$ l.). —Larg 0^m, 0017 à 0^m, 0026 ($\frac{3}{4}$ à $1\frac{1}{4}$ l.). Patrie: l'Amerique septentrionale. (Collect. Chevrolat, Dejean (type), Dupont, Leconte.)

"♂ Tête flave. Prothorax flave en devant et sur les côtés, noir à la base; la région noire, couvrant les deux tiers médiaires du bord postérieur, quadrifestonnée en devant, à festons médiaires avancés jusqu'au quart ou au cinquième antérieur, profondément divisés entre eux sur la ligne médiane. Epimères du médipectus et pieds, flaves.

"♀ Tête jaune, avec l'épistome et parfois la partie antérieure du front, noirs, obscurs ou nébuleux. Prothorax noir, paré de chaque côté d'une bordure jaune, étendue en devant jusqu'à la sinuosité postoculaire, ordinairement de largeur égale, jusqu'aux deux cinquièmes ou jusqu'à la moitié de la longueur, et rétrécie ensuite en ligne un peu courbe de là à l'angle postérieur, quelquefois rétrécie directement de la sinuosité à l'angle postérieur. Epimères du médipectus, noires. Pieds jaunes. Cuisses en partie noires, sur une étendue basilaire variable."

In the notes following the description Mulsant speaks of the narrow separation of the basal pale spots of the elytra and states that they are sometimes united, clearly indicating the variety for which I have retained the name *confusa*.

B. 4-punctata flavifrons *Muls.*

1851. Species Trimeres Securipalpes, p. 531. The original description in part reads:

"Obtusément ovale. Elytres noires, parées chacune de trois taches subarrondies, jaunes ou orangées: la première, liée à la base dont elle couvre les trois cinquièmes internes: la deuxième, unie au bord externe du tiers aux quatre septièmes: la troisième, subapical, de moitié plus rapprochée du bord externe que de la suture.

"Long. 0^m, 0026 à 0^m, 0033 ($1\frac{1}{4}$ à $1\frac{1}{2}$ l.).— Larg. 0^m, 0019 à 0^m, 0022 ($\frac{7}{8}$ à 1 l.). Patrie: l'Amerique septentrionale. (Collect. Dejean (type), Dupont.)"

This description covers a variety of *4-punctata* in which the marginal spot, as well as the two basal and the subapical spot is present and I have

included with it that form in which the discal spot is represented by a faint spot or tiny dot which would otherwise be nameless. The humeral spot is not mentioned in that part of Mulsant's description quoted but, later on he says the male has this spot in addition.

B. albifrons *Say.*

1824, Journ. Acad. Nat. Sci. Phila., IV, p. 94. Mulsant, 1851, Species des Coléop. Trim. Sécuri., p. 1049. Crotch, 1873, Trans. Am. Ent. Soc., p. 378; 1874, Revision, p. 212. Gorham, 1899, Biologia, VII, p. 189. Casey, 1899, Jour. N. Y. Ent. Soc., VII, p. 119.

Original description: "Elytra yellow; suture and two spots on each, black; head and anterior part of the thorax whitish.

"Inhabits Missouri.

"Head yellowish: thorax black; anterior and lateral margins, and abbreviated line before, white: elytra, with the suture, tip, outer edge, and two spots, black; spots placed one near the humerus and the other behind the middle. Length less than one fifth of an inch.

"Taken on the Missouri by Mr. T. Nuttall."

Length: 4.0 to 4½ mm.

Other localities: Nebraska, Colorado and Montana.

In this and the two following species we have the most distant derivatives of *ursina,* if in their greatly modified form they may be so regarded. The form is more oblong, the excavation of the ♂ fifth ventral segment is more pronounced, the margin of the segment is produced over the succeeding segment and the maculation is so modified that its relation to that of *ursina* is hardly recognizable. In Say's description the elytra are yellow with the suture and two spots on each black, but enormous individual variation occurs and, as indicated in Fig. 46 to 49, the extension of the black pigment more or less completely unites the black spots with the suture producing a pattern closely approaching that of *illustris* (Fig. 50). The head is pale in both sexes; the pronotum, as usual, is paler in the ♂ (Figs. 46 and 48) than in the ♀ (Figs. 47 and 49). I am indebted to Prof. R. H. Wolcott for an opportunity of studying a series of about forty specimens of this species taken in Sioux Co., Nebraska, which with other material showed an astonishing series of variations.

B. illustris *Casey.*

1899, Journ. N. Y. Ent. Soc., VII, p. 118.

Original Description: "Elytra with the basal and lateral margin pale and each with a discal pale spot; oblong-oval, black, the head and oblique sides of the pronotum angularly lobed within at the middle, pale in the female, the apical margin also very narrowly pale, the prothorax ⅔ longer at the middle than at the sides, finely,

sparsely punctate; elytra with a narrow rufo-flavate margin from the scutellum to the sides, narrowest at outer $\frac{2}{5}$, the lateral margin obliquely pale at the humeri, the pale side margin extremely narrow at basal fourth, then dilated to outer fourth at the middle opposite the discal pale spot, then narrowed at apical fourth, thence gradually expanded and extending transversely to within $\frac{2}{3}$ of its apical width of the suture, receding somewhat from the side margin as in the *fimbriolata* group of Hyperaspis; punctures fine but strong, moderately sparse, closer near the base; under surface black throughout, the femora blackish, paler at apex. Length 4.1 mm.; width 3.0 mm. Colorado (Beaver Brook, 6000 feet elevation)."

I have repeated the original description verbatim. Fig. 50 is copied from a sketch kindly furnished by Col. Casey.

B. pacifica *Casey.*

1899, Journ. N. Y. Ent. Soc., VII, p. 119.

Original description: "Elytra pale, each with two black spots, one anterior and one posterior; narrowly oval, with flavate pale areas anteriorly, reddish on the elytra, finely, not closely punctulate; male with the head pale, the pronotum black in a basal area between the basal angles, the anterior margin of which curves evenly from the basal angles to anterior third at lateral $\frac{2}{5}$, then feebly sinuate and then extending forward in two rounded lobes separated by a narrow deep fissure to apical fifth or sixth; scutellum black; elytra pale, the suture more or less broadly black from the scutellum to the apex, narrowly at the scutellum and for a short distance just behind the middle, the external marginal head also black, becoming broader at the apex and joining the sutural black area; anterior black spot obliquely oval, sending off a nubilous connecting isthmus to the sutural black area, the posterior spot smaller, at apical and outer third; under surface black throughout, the posterior femora in great part black, the intermediate less so. Length 3.7 mm.; width 2.4 mm. California (Sta. Monica)."

As in the case of the preceding species, I have repeated the original description of *pacifica* which I have not seen. Fig. 51 is copied from a sketch received from Colonel Casey, who has also in a letter given me the following details of the ♂ sexual characters; "of the *ursina* type except that the subapical impression of abdomen is feebler, in fact scarcely truncate, being more diffused or more properly flattened."

Group 5.

This group includes four species, inhabiting Central America, peculiar alike in ornamentation and in abdominal structure in the males. In the preceding groups the sexual modification did not involve the second visible segment. In this group the second, third, fourth and fifth segments ♂ are involved. Each segment is arcuately depressed and the depression is limited on either side by a cusp approaching in form that of the first group.

The complete result is as if the entire abdomen were longitudinally grooved beneath. In respect of maculation, the pronotum is either broadly pale in front or bears pale discoidal marks or (*aperta*) is entirely pale with black V-mark; the elytral markings are five pale spots (in *fenestrata*), four pale spots (in *pygidialis*) or consist of dark markings on a pale ground in the other species; even the pygidium bears a reddish spot in *pygidialis*. The four species do not seem to be closely related between themselves.

B. fenestrata *Gorham.*

1899, Biol. Cent. Amer., VII, p. 190.

Original description: "Breviter ovata, nigro-picea, nitida; capite, prothoracis lateribus late, et maculis duabus discoidalibus, elytrorum maculis quinque pedibusque, flavis. Long. 3.25 mm. Mas capite et prothoracis margine antico albido-flavis, abdomine medio fossulato. Hab. Mexico, Teapa in Tabasco (H. H. Smith); Costa Rica, Caché (Rogers); Panama, Volcan de Chiriqui, Bugaba (Champion)."

"Easily recognized by the thorax having two pale oval spots near the middle of the base, almost but not quite touching it. . . . the elytral markings are very pale yellow, almost white in some male examples. The fossa on the abdomen of the males is very distinct, and the middle of the metasternum is also impressed; the margins of the segments are raised in the middle and at the sides of the fossa almost tuberculate. The female has the head yellow, but the front of the thorax is pitchy-black. The specimens from Teapa diverge from the type in having the black mark on the thorax divided by a wedge-shaped spot in front. The Bugaba specimens have the dark markings of a pitchy-red colour." See Fig. 74.

B. cachensis *Gorham.*

1899, Biol. Cent. Amer., VII, p. 190.

Original description: "Pallide albido-testacea, nitida, corpore subtus piceo; prothorace maculis tribus cuneiformibus conjunctis, una mediana, duabus basalibus, elytris sutura maculisque duabus in singulis, nigris. Long. 4 mm. ♂ Hab. Costa Rica, Caché (Rogers)."

"At first sight resembling *B. lepida*, but to be immediately distinguished from it or from any other *Brachyacantha* known to me by the marking of the prothorax which is like a broad-arrow ⋎, with the barbs lying on the V-shaped base. The suture has not a distinct spot (as it has in *B. lepida*), but is more widely pitchy-black immediately below the scutellum than at the apex. The legs are entirely pale testaceous. The male character of an impressed fossa along the middle of the abdomen is very distinct, but its sides are apparently not tubercular. A single specimen, in rather bad condition." Fig. 73.

B. aperta *Weise.*

1903, Deutsche Ent. Zeits., p. 208.

Original description: "Breviter ovalis, sat convexa, flavo-albida, uitida, crebre punctulata, prothorace limbo basali utrinque dilatata maculaque apicali, litteram V formante piceis, scutello piceo, elytris subtilissime piceo-circumcinctis, singulo linea subflexuosa ramis tribus exserente picea. Long. 3, 3 mill.

"Costa Rica: Turrialba (Schild-Burgdorf)."

"Die dunkle Langslinie jeder Fld. beginnt an der Basis vor der Schulterbeule, lauft uber diese hinweg bis hinter die Mitte und ist etwas vor der Mitte nach innen gebogen. Sie sendet 3 Queraste aus, 2 bis an den Seitenrand, der erste hinter der Schulter, schrag nach hinten und aussen, der zweite hinter der Mitte, bogenformig, nach hinten geoffnet; der dritte Ast lauft in der Mitte nach innen bis in die Nahe der Naht, die er nicht erreicht. Der Zahn der Vorderschienen ist kurz und stark, die Klauen besitzen ein grosses zahnformiges Anhangsel am Grunde."

The male has the longitudinal fossa well developed. See Fig. 75.

B. pygidialis *Muls.*

1851, Species des Coléop. Trim. Securi., p. 534. Crotch, 1874, p. 212. Gorham, 1899, VII, p. 187.

Original description, abridged: "Ovale ou en ovale-oblong. Elytres noires, ornées chacune de quatre grosses taches jaunes: la première, basilaire, subcordiforme; la deuxième, en triangle, liée au rebord externe, du quart aux trois cinquièmes: la troisième juxta-suturale, subarrondie, du tiers aux trois cinquièmes: la quatrième, subterminale. Pygidium noir, noté d'une tache orangée."

Length: 4.5 mm.

Habitat: Mexico (type locality), also Jalapa and Orizaba in Mexico.

The male head is pale; thorax pale with black basal spot covering three fourths of the base, oblique at sides, arcuately emarginate in front; elytra black with five pale spots, two basal, confluent, one marginal in front of the middle, one discal at the middle, one subapical, all large rounded; thorax beneath and legs pale, abdomen and body black. In the female the thorax is black with the sides pale and a pale spot at middle; the elytra lack the humeral spot. Pygidium black, marked with an orange spot. The male abdomen is longitudinal fossulate as in the other species of the group but the edges of the fossa are not cuspid. See Fig. 79.

Group 6.

This last group contains two heterogeneous sections which, however, agree in having the ♂ abdominal segments simple and devoid of any of

the special modifications noticed in the preceding groups. The first section contains, so far as known, only one species (*querceti*). It is confined to Florida. The material from the West Indies is, however, scanty in all tribes of Coccinellidæ and it is possible allied species may later be found in these islands. The elytra in *querceti* are black with a subquadrate humeral red spot and a rounded subapical spot of the same color, a type of marking not observed elsewhere in the genus. The second section contains the well known *lepida* and allied species ranging from northern Mexico (even Texas according to Gorham) to Paraguay. In them the elytra are pale with rounded spots of which one is often expanded to form a conspicuous rounded common sutural spot.

B. querceti *Sz.*

1878. Proc. Am. Phil. Soc., XVII, p. 362.

Original description: "Rounded, convex, shining, black; head and thorax finely not densely, elytra somewhat more strongly punctured. Each elytron with a large, transverse humeral spot, which is obliquely truncate inside and leaves a very narrow basal margin black and with a smaller, rounded-oval spot at the outer apical angle not touching the margin, orange red. Side pieces of metasternum and sides of abdomen densely punctured, propleuræ and legs yellow, femora infuscate at base. Length 2–2.75 mm.; .08–.11 inch."

"♂ Head, front margin of thorax narrowly, anterior angles and side margin more broadly, epimera of mesosternum entirely whitish-yellow." (Fig. 58.)

"♀ Head black, or piceous in front, thorax black or with the front margin and front thorax black or with the front margin and front angles narrowly piceous-testaceous, epimera black or piceous." (Fig. 59.)

"var. α. Humeral spot small and narrow."

"var. β. Humeral spot interrupted at middle."

"Widely distributed in Florida; abundant on oak shrubs."

The second variety is seldom found in the collections I have seen.

B. lepida *Muls.*

1851. Species des Coléop. Trim. Securi., p. 523. Dejean, 1837, p. 458. Crotch, 1873, p. 378; 1874, p. 210. Gorham, 1899, p. 185.

var. α. Gorham, *l. c*, p. 185.

Original description: "Obtusément ovale; convexe. Elytres jaunes parées sur la suture d'une bordure suborbiculairement renflée du cinquiéme à la moitié, et dilatée des trois quarts aux neuf dixièmes de la longueur, et chacune de deux raches suborbiculaires, noires; l'antérieure, couvrant en devant le calus: l'autre, sur la même ligne longitudinale, de la moitié aux deux tiers de la longueur."

Length: 2.5–3.6 mm.

Habitat: Mexico (type locality); Texas (Crotch); Honduras; Guatemala; Costa Rica; Jalapa, Vera Cruz, and Tobasco, Mexico.

It is yellow with sternum, middle of ventral segments and base of femora black; thorax with the base broadly black, black area quadridentate in front; elytra with a black sutural border expanded into a common sutural spot and with two rounded spots, the first before the second behind the middle. The sutural border forms a recurved hook just in front of the apex.

The male and female markings are almost exactly alike — the female being a little darker on the head and beneath. The male can be distinguished by the 7th segment beneath and emarginate 5th segment. Fig. 60 ♂, Fig. 61 ♀.

Var. *a.* Gorham, spots rufo-piceous instead of black, may be based upon immature specimens, but it is not unusual to find individuals of the color described.

B. lepida confluens *Weise.*

1898, Arch. für Naturg., LXIV, p. 237. var. *β*: Gorham, 1899, Biol. Cent. Amer., VII, p. 185.

Original description: "Elytris nigris, limbo laterali trifariam dilatato maculisque tribus in singulo elytro, 1, 1, 1 collocatis, flavis."

"Die schwarzen Makeln der Flügeldecken dehnen sich aus und verbinden sich miteinander, anfangs die beiden auf jeder Decke der Lange nach, sodann auch mit den beiden Nahtmakeln der Quere nach; dann bleibt ein schmaler Saum am Seitenrande, an der Basis, in der Mitte und vor der Spitze etwas erweitert, sowie eine Längsreihe von 3 Makeln auf jeder Decke gelb: Makel 1 am Basalrande, 3 in der Mitte, 3 vor der Spitze."

In this variety the spots are confluent so as to leave a pale margin internally with three disconnected spots. Fig. 62 represents an approach to it.

B. lepida reducta n. var.

Same shape and color as *lepida* but with the black markings reduced to a narrow sutural border, not expanded and without the ante-apical recurved hook, and two discal spots in the same position as those of *lepida* but much smaller. The black basal area of prothorax is not quadridentate as in *lepida* but the apices of the central projections are represented by two detached spots.

Length: 2.5 mm.

Habitat: Pacayas, Costa Rica.

B. sellata *Muls.*

1851, Species des Coléop. Trim. Securi, p. 522. Dejean, 1837, p. 458. Crotch, 1874, p. 210.

Original description, abridged: "Obtusement ovalaire. Elytres jaunes, parées d'une bordure suturale et d'une externe, noires: celle-ci, ne couvrant à peu près

que le rebord externe, un peu moins étroites posterieurement: ornées d'une tache commune, presque carrée, couvrant du cinquième aux trois cinquièmes de la suture, et chacune de deux taches subarrondies, également noires: l'anterieure, couvrant en devant le calus: l'autre, plus grosse, sur la méme ligne longitudinale, entre cette dernière et le bord postérieur."

Length: 3.6–4.8 mm.

Habitat: Brazil (type locality).

The elytra are yellow with black sutural and external border, the latter covering hardly more than the epipleuræ but a little wider behind, and with a common sutural spot and two discal rounded spots, the first in front covering the callus, the second larger behind the first and between it and the apical margin.

♂ Head yellow. Thorax yellow with basal black area, covering two thirds of the base, bifestooned in front, or formed of two basal blotches rounded in front, connected with the base and with a little spot in front of the scutellum, which is yellow margined with black.

♀ Head black, labrum yellow. Thorax black, with yellow lateral border, reaching in front to the postocular sinuosity, obliquely limited in front, of uniform width behind to the hind angle. Scutellum black.

B. bruchi *Weise.*

1902, Rev. Mus. La Plata, XI, p. 193.

"Obtuse ovalis, convexa, nigra, antennis, palpis maxillaribus articulo ultimo tarsisque testaceis, limbo laterali prothoracis elytrisque citrinis, his dense subtiliter punctulatis, limbo apicali, sutura, macula communi rotundata ante medium maculisque binis rotundatis in elytro singulo nigris.

"Mas: capite, limbo apicali prothoracis, utrinque late et parum profunde arcuatim emarginato, epimerisque intermediis citrinis, pedibus anticis testaceis."

"Brachyacanthæ sellatæ Muls. certe similis, prothorace aliter signato, macula communi elytrorum minore, rotundata, al illa differt. Caput subtilissime punctulatum, vel nigrum, margine antico clypei rufescente (♀), vel citrinum (♂) antennis, mandibulis articuloque ultimo palporum testaceis. Prothorax capite paullo fortius, dense punctulatus, feminæ niger, antice subtiliter ferrugineo marginatus, limbo laterali citrino, intus late arcuatim emarginato; maris niger, limbo laterali et apicali citrinis, hoc sat lato, postice medio parum triangulariter,—utrinque magis angulatim-dilatato. Scutellum nigrum, punctulatum. Elytra prothorace paullo subtilius punctulata, citrina, sutura anguste margineque apicali latius nigro-limbatis, margine laterali (basi excepta) angustissime infuscato vel nigro, macula communi ante medium, rotundata, haud vel leviter transversa, maculisque duabus in singulo elytro nigris; prima rotunda, subhumerali, pone basin supra marginem locata, secunda pone medium supra marginem, rotundata, primae vix vel parum majore, leviter transversa, subobliqua. Corpore subtus nigrum, aut lateribus prosterni citrinis, tarsis testaceis, genubus tibiisque anticis interdum rufescentibus (♀), aut pedibus anticis, epimeris intermediis coxique omnibus testaceis femoribus tibiisque intermediis inferne parum rufescentibus." Fig. 87.

The original description of this species, of which I have not been able to see a series, is repeated verbatim. From this description and a specimen loaned by Dr. Sicard (from which Fig. 87 has been made) *bruchi* seems to be very close to *sellata,* differing in the pronotum of the female having the front margin as well as the sides narrowly pale and in the smaller common elytral spot.

[Note: *B. metator* Casey, Can. Ent., XL, p. 413, is stated by the author in a later publication (Can. Ent. XLII, p. 105) to be a *Hyperaspis* and is therefore here omitted.]

[Note. The following names are quoted by Mulsant as unpublished.

B. agathina Reiche i. litt. = *B. lepida*

B. dorsalis Chev. i. litt. = *B. lepida*

B. designata Chev. Dej. Cat. = *B. 4-punctata confusa.*

B. erythrocephala Bosc. Dej. Cat. = *B. 4-punctata flavifrons.*

B. 5-maculata Buquet, Dej. Cat. = *B. sellata.*

The last named was considered a variety by Buquet but placed as a synonym by Mulsant. The others were names that had been applied in the collections of the owners of the specimens and of which no descriptions had been published. Mulsant in many instances adopted such cabinet names but in these instances preferred to supply more descriptive names.]

Bibliography.

Bowditch, F. C., 1902. Notes on Casey's Revision of the American Coccinellidæ. *Entomological News,* pp. 205 and 206.

Casey, Thos. L., 1899. A Revision of the American Coccinellidæ. *Journal New York Entomological Society,* VII, pp. 7–169.

—— 1908. Notes on the Coccinellidæ. *Canadian Entomologist,* XL, pp. 393–421

—— 1910. Synonymical and other Notes on Coleoptera. *Canadian Entomologist,* XLII, pp. 105–114.

Chevrolat, A., 1842. Description of the genus Brachyacantha. Dictionnaire universel d'Histoire Naturelle par D'Orbigny.

Chapuis, J., 1876. Discussion of the genus Brachyacantha in connection with families Coccinellidæ, Erotylidæ etc. Lacordaire's Histoire naturelle des Insectes, XII, p. 228.

Crotch, G. R., 1873. Revision of the Coccinellidæ of the United States. *Trans. American Entomological Society,* pp. 363–382.

—— 1874. A Revision of the Coleopterous Family Coccinellidæ. London, 8vo. 311 pp.

Dejean, Le Comte, 1837. Catalogue des Coléoptères, 3rd edition, Paris. [No descriptions given.]

Fabricius, J. C., 1775. Systema Entomologiæ.

—— 1787. Mantissa Insectorum.

—— 1792. Entomologia Systematica Emendata.

—— 1801. Systema Eleutheratorum.

Gorham, H. S., 1899. Biologia Centrali-Americana, Insecta, Coleoptera, VII.

Kirsch, Th., 1876. Beitrage zur Kenntniss der Peruanischen Käferfauna. *Deutsche Entomologische Zeitschrift*, XX, pp. 81–133.

Leconte, John L., 1858. Description of New Species of Coleoptera, chiefly collected by United States and Mexican Boundary Commission. *Proceed. Academy Natural Sciences of Philadelphia*, pp. 59–89.

—— 1859. Coleoptera of Kansas and Eastern New Mexico. Smithsonian Contributions to Knowledge.

Melsheimer, F. E., 1847. *Proceed. Academy Natural Sciences of Philadelphia, III.*

Mulsant, E., 1851. Species des Coléoptères Triméres Securipalpes, Lyon, 8vo., 1104 pp.

—— 1856. Additions et Rectification au Catalogue des Coccinellides. *Annales de la Societé Linnéenne de Lyon.* III.

Nunnenmacher, F. W., 1909. *Entomological News.*

Olivier, A. G., 1808. Entomologie, VI.

—— 1810. Encyclopedie Méthodique.

Say, Thomas, 1824. Descriptions of Coleopterous Insects collected in the late Expedition to the Rocky Mountains under the command of Major Long. *Journ. Academy Natural Sciences of Philadelphia*, IV.

—— 1835. *Boston Journal Natural History*, I, pp. 151–203.

Schaeffer, Chas., 1908. *Journ. New York Entomological Society*, XVI.

Schwarz, E. A., 1878. *Proceed. American Philosophical Society*, XVII.

Smith, John B., 1886. Ants' Nests and their Inhabitants. *American Naturalist*, XX, pp. 679–687.

Verhoeff, C., 1893. Vergleichende Untersuchung über die Abdominal segmente und die Copulations organe der männlichen Coleoptera. *Deutsche Entomologische Zeitschrift*, pp. 113–170.

—— 1895. Beiträge zur vergleichenden Morphologie des Abdomens der Coccinelliden. *Archiv. für Naturgeschichte*, LXI, pp. 1–80.

Weise, Julius, 1885. Beschreibung Einiger Coccinelliden, *Stettiner Entomologische Zeitung*, XLVI.

—— 1898. Ueber bekannte und neue Coccinelliden. *Archiv. für Naturgeschichte*, LXIV, pp. 225–238.

—— 1902. Coccinelliden aus Süd-amerika, III. *Deutsche Entomologische Zeitschrift*, pp. 161–176.

—— 1903. Drei neue Coccinellen. *Deutsche Entomologische Zeitschrift*, pp. 207–208.

—— 1904. Coccinellidæ in Argentinia, Chili et Brasilia. *Revista del Museo de La Plata*, XI, pp. 193 to 198.

—— 1904. Synonymische Bemerkungen zu Gorham, Biologia Centrali-Americana, vol. VII, Coccinellidæ. *Deutsche Entomologische Zeitschrift*, pp. 357 to 364.

Wheeler, William Morton. 1911. An Ant-Nest Coccinellid (Brachyacantha quadripunctata Mels.). *Journal of the New York Entomological Society*, XIX, pp. 169 to 174.

20 ♀ 21 ♀ 22 ♀ 23 ♀ 24 ♂ 25 ♀ 26 ♂ 27 ♂

28 ♀ 29 ♀ 30 ♀ 31 ♀ 32 ♀ 33 ♂ 34 ♂ 35 ♂

36 ♀ 37 ♂ 38 ♂ 39 ♂ 40 ♀ 41 ♂ 42 ♂ 43 ♀

44 ♂ 45 ♂ 46 ♂ 47 ♀ 48 ♂ 49 ♀ 50 51

52 ♂ 53 ♂ 54 ♂ 55 ♀ 56 ♂ 57 ♀ 58 ♂ 59 ♀

Explanation of Figures 20–92.

The figures in the text (1–14) were first drawn by the author and afterwards redrawn by Mr. John A. Grossbeck, of the American Museum of Natural History, using a dissecting microscope. The hairs are omitted to avoid confusing the outlines of the parts of the legs.

The drawings of the elytra of the different species are to be understood as diagrams of the type of maculation and no attempt has been made to represent the size or varying shape or punctuation.

Fig. 20.	*B. dentipes* var. *separata*	♀	page		301
" 21.	" " " "	♀	"		301
" 22.	" " typical	♀	"		300
" 23.	" " var. *socialis*	♀	"		301
" 24.	" " " "	♂	"		301
" 25.	" *tau*	♀	"		305
" 26.	" "	♂	"		305
" 27.	" "	♂	"		305
" 28.	" *quadrillum*	♀	"		303
" 29.	" *erythrura*	♀	"		302
" 30.	" *subfasciata*	♀	"		302
" 31.	" *blaisdelli*	♀	"		304
" 32.	" *ursina*, typical	♀	"		309
" 33.	" " "	♂	"		309
" 34.	" " var. *stellata*	♂	"		310
" 35.	" " " *congruens*	♂	"		310
" 36.	" " " *uteella*	♀	"		310
" 37.	" *arizonica*	♂	"		314
" 38.	" "	♂	"		314
" 39.	" "	♂	"		314
" 40.	" " var.	♀	"		314
" 41.	" "	♂	"		314
" 42.	" *bollii*	♂	"		314
" 43.	" " var.	♀	"		314
" 44.	" *octostigma*	♂	"		311
" 45.	" *testudo*	♂	"		312
" 46.	" *albifrons*	♂	"		320
" 47.	" "	♀	"		320
" 48.	" " approaching *illustris*	♂	page		320
" 49.	" " " "	♀	"		320
" 50.	" *illustris* (copied from sketch by Casey).		page		320
" 51.	" *pacifica* " " " " " "				321
" 52.	" *4-punctata*	♂	page		316
" 53.	" " var. *flavifrons*	♂	"		319
" 54.	" " " *confusa*	♂	"		319
" 55.	" " (= *basalis*)	♀	"		316
" 56.	" *indubitabilis*	♂	"		315
" 57.	" "	♀	"		315
" 58.	" *querceti*	♂	"		324
" 59.	" "	♀	"		324

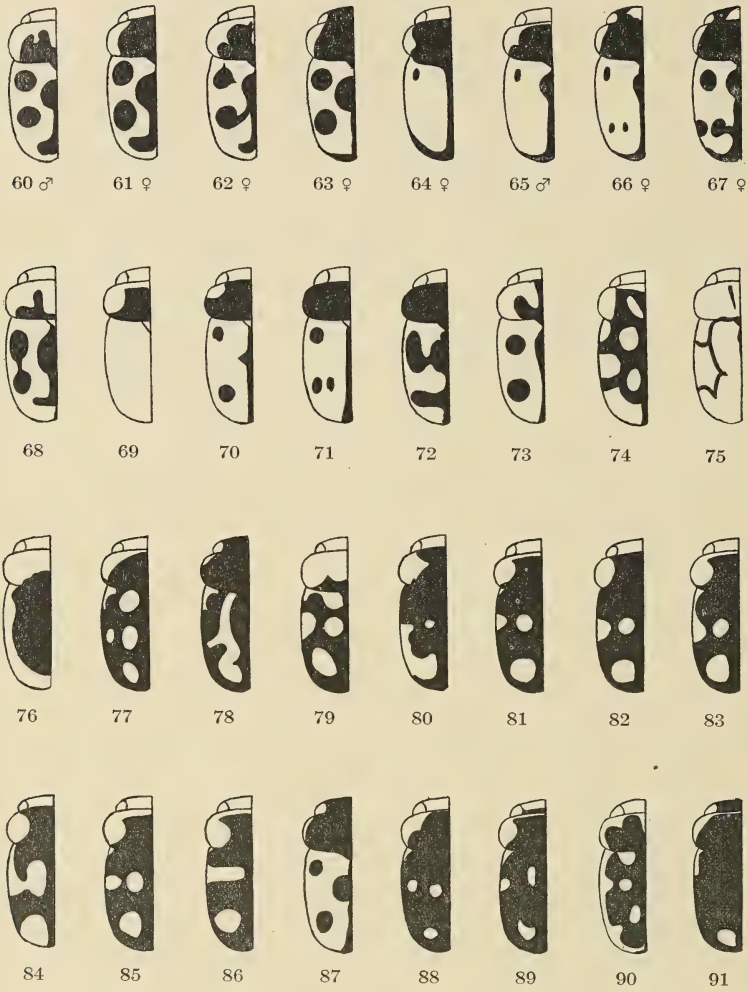

60 ♂
61 ♀
62 ♀
63 ♀
64 ♀
65 ♂
66 ♀
67 ♀
68
69
70
71
72
73
74
75
76
77
78
79
80
81
82
83
84
85
86
87
88
89
90
91

Fig. 60.	*B. lepida*	♂	page		324
" 61.	" "	♀	"		324
" 62.	" " var. *confluens*	♀	"		325
" 63.	" *sellata*	♀	"		325
" 64.	" *ay mardi*	♀	"		307
" 65.	" "	♂	"		307
" 66.	" "	♀	"		307
" 67.	" "	♀	"		307
" 68.	" *lepida*	(copied from figure in Biologia).		page	324
" 69.	" *westwoodii*	" " "	"	" "	305
" 70.	" *aymardi*	" " "	"	" "	307
" 71.	" *cryptocephalina*	" " "	"	" "	307
" 72.	" *conjuncta*	" " "	"	" "	306
" 73.	" *cachensis*		page		322
" 74.	" *fenestrata*		"		322
" 75.	" *aperta*		"		323
" 76.	" *buckleyi*		"		294
" 77.	" *australe*		"		313
" 79.	" *pygidialis*		"		323
" 80.	" *obscura* (var. of *bistripustulata*)		"		299
" 81.	" *bistripustulata* ♂		"		296
" 82.	" " ♀		"		296
" 83.	" " var. *guttata*		"		297
" 84.	" " " *quichiana*		"		298
" 85.	" " " *decora*		"		298
" 86.	" *americana* (var. of *dentipes*)		"		302
" 87.	" *bruchi*		"		326
" 88.	" *fenyesi* ♂		"		316
" 89.	" *mexicana* ♂		"		316
" 90.	" *12-guttata*		"		294
" 91.	" *3-maculata*		"		295
" 92.	" *sicardi*		"		295

59.9 (91)

Article XIII.—MAMMALS COLLECTED IN THE DUTCH EAST INDIES BY MR. ROY C. ANDREWS ON THE CRUISE OF THE 'ALBATROSS' IN 1909.

By J. A. Allen.

Through the courtesy of the U. S. Fish Commission, Mr. Roy C. Andrews, Assistant Curator of Mammalogy, American Museum of Natural History, was appointed to join the scientific staff of the U. S. Fish Commission steamer 'Albatross' on its cruise in the Indian Archipelago in 1909, to collect natural history material in the interest of the American Museum. Mr. Andrews left New York August 25, and joined the 'Albatross' at Manila October 10. The opportunities for collecting land animals proved to be infrequent and of short duration, varying from a few hours to two or three days, while the steamer was coaling at the various ports visited. Notwithstanding this handicap Mr. Andrews obtained about 50 specimens of mammals, including skeletons of several species of monkeys, etc., an important collection of birds numbering about 425 specimens, and much anthropological material.

The principal localities at which mammals were collected are: Mindoro, Philippine Islands; Tawao and Sebattik Island, British North Borneo; Limbé Strait, Northeast Celebes; Garontalo Gulf, North Celebes; Buton Island, Southeast Celebes; Bouru Island, Molucca Islands.

I also include in this paper (by permission) the description of a new squirrel from Borneo, collected by Mr. C. William Beebe, Curator of Birds, New York Zoölogical Society, on the Kuser Asiatic Expedition, and an apparently undescribed squirrel from Formosa, recently acquired by purchase.

1. **Phalanger ursinus** *Temminck.*

One specimen, adult male, skin and skeleton, Limbé Strait, Northeast Celebes, Nov. 12, 1909.

2. **Sus celebensis** *Müller & Schlegel.*

Adult male, skin and skeleton, Limbé Strait, Northeast Celebes, Nov. 12, 1909.

3. **Bubalus mindorensis** *Heude.*

Adult male, skin and skeleton, near mouth of Bongalon River, Mindoro, Philippine Islands. This specimen was collected for the Museum on Mr. Andrews's order after he left the Philippines.

4. **Tragulus borneanus** *Miller.*

Young male (about half grown), skin and skeleton, Sebattik Island, British North Borneo. November 3, 1909.

5. **Mus rajah** *Thomas.*

Two specimens Sebattik Island, British North Borneo, November 3, 1909.

6. **Mus mindorensis** *Thomas.*

One specimen, Calapan, Mindoro, Philippine Islands, Oct. 19, 1909.

7. **Mus neglectus** *Jentink.*

Two specimens, Sebattik Island, British North Borneo. These probably represent an insular form of the *neglectus* group. Tail unicolor dark brown and *naked.*

8. **Mus andrewsi** sp. nov.

Type, No. 32193, ♂ ad., Buton Island, Celebes, Dec. 13, 1909; coll. Roy C. Andrews, for whom the species is named.

Fur long and soft, without spines. General color of the whole dorsal region cinnamon rufous finely grizzled with black-tipped and white-tipped hairs, the former prevailing, the hairs being grayish plumbeous at base darkening to blackish and broadly ringed subapically with pale rufous, and for the most part tipped narrowly with black, mixed with many wholly black-tipped hairs and a few light-tipped hairs; sides of the body similar in color to the back but much lighter; ventral surface whitish gray, the hairs darker but still light gray basally; top of head to nose like the back or slightly lighter; limbs like the sides of the body; feet flesh-colored, scantily clothed with short glistening white hairs; ears large, naked, much longer than broad, dark brown above and on sides, flesh color below and all around at the extreme tip.

Total length (type), 260; head and body, 147; tail, 113, hind foot, 38. Skull, total length, 42; zygomatic breadth, 20; breadth of braincase, 15; length of nasals, 17; greatest breadth of nasals, 6; length of palate, 17 2; diastema, 11; upper toothrow, 7.6.

A second specimen has practically the same external measurements, but is a much younger adult, as shown by the skull, the teeth being wholly unworn, and the skull less heavily ossified and much smaller, the total length being 39 mm. as against 42 mm. in the type, in which the teeth are greatly worn.

This species has many points of resemblance to *Mus luzonensis* Thomas, not only in coloration and proportions but in cranial characters. The type shows a tendency to albinism through the presence of scattered white hairs and one or two small bunches of white hairs on the back, and an irregular submedian line of wholly white hairs on the ventral surface.

9. **Mus buruensis** sp. nov.

Type, No. 31296, ♂ ad., Bouru Island, Molucca Islands, Dec. 11, 1909; coll. Roy C. Andrews.

Pelage short, soft, and somewhat glossy, mixed abundantly with spiny hairs over the middle of the back.

General color above pale rufous brown strongly varied with black, which is the prevailing tone of the mid-dorsal region, varying to rufous from the loins posteriorly, where the pelage is longer, softer, and spineless; top of the head like the back; sides paler, passing gradually into the silvery gray of the ventral surface, where the hairs are dark gray at base and broadly tipped with whitish, with a faint wash of pale rufous over the pectoral region; outer surface of the limbs like the adjoining region, inner surface grayish white like the ventral surface; fore feet edged with flesh color with a dusky line down the middle extending nearly to the end of the toes; hind feet rusty blackish with the edges silvery gray, the hairs short and glistening; ears dark brown, nearly naked; tail slightly longer than the head and body, wholly dark brown, sparsely haired apically and tipped with a slight pencil of black hairs.

Total length, 210; head and body, 95; tail, 115; hind foot, 26. The skull is imperfect, lacking the occipital portion. Length from tip of nasals to frontoparietal suture, 21.5; length of nasals, 12; greatest breadth of nasals, 4; interorbital breadth, 5.5; breadth of braincase, 13; palatal length, 14; length of upper toothrow, 6; diastema, 8.

This species should be compared with *Mus musschenbroekii* Jentik, from Menado, Celebes, which it resembles in coloration and in the character of the spinous pelage, but from which it differs in much smaller size and relatively much longer tail. The single specimen (type) is a fully adult male, in good condition except that it lacks the occipital portion of the skull.

10. **Sciurus rufoniger pluto** (*Gray*).

Two specimens: female, Tawao, British North Borneo, Jan. 2, 1910; male, Sebattik Island, British North Borneo, Jan. 3, 1910.

11. **Pteropus alecto** *Temminck.*

Seven specimens — 2 skins, 5 alcoholics. Buka Island, Gulf of Gorontalo, Celebes, Nov. 20, 1909.

"Found hanging on trees in great numbers, estimated at about 20,000." — R. C. A.

12. **Nasalis larvatus** (*Wurmb*).

A young female, Sebattik Island, Northeast Borneo, Jan. 10, 1910.

13. **Cynopithecus niger** (*Desmarest*).

Eight specimens, Limbé Strait, Northeast Celebes, Nov. 12, 1909, as follows: 1 skin with complete skeleton, 2 skins with skulls, 2 skins without skulls (killed by sailors and skulls destroyed), and 3 skulls with head skins only.

14. **Magus ochreatus** (*Ogilby*).

Five specimens, 1 adult male, 3 adult females, 1 female half-grown, Burton Island, Southeast Celebes, Dec. 13, 1909.

The following external measurements were taken:

No.	30613,	♂,	total	length	530;	tail	vertebræ,	35.
"	30612,	♀,	"	"	450;	"	"	35.
"	30611,	♀,	"	"	475;	"	"	28.
"	30610,	♀,	"	"	440;	"	"	45.
"	30614,	♀,	"	"	250;	"	"	20.

"All were killed out of a single tree. There were two others which, although badly wounded, escaped." — R. C. A.

No. 30611 is albinistic, the general coloration being much lighter than in the others, the top of the head and neck posteriorly to the shoulders being nearly white, with whitish areas on the fore arms and sides of the body.

15. **Pithecus philippinensis** (*Is. Geoffroy*).

One young male, Calapan, Mindoro, Philippine Islands, Oct. 19, 1909.

16. **Pithecus mandibularis** *Elliot.*

Four specimens: Sebattik Island, British North Borneo, Jan. 4, 1910, 3 females, one an old adult, the others young; Tewao, British North Borneo, Jan. 2, 1910, young male.

New Squirrels from Borneo and Formosa.

Sciurus beebei sp. nov.

Type, No. 32624, ♀ ad. (original number Bo. 40), 10 miles south of Kuching, Sarawak, Borneo, June 26, 1910; coll. of Mr. C. William Beebe, for whom the species is named.

Upperparts uniform olive gray from nose to base of tail, including flanks; the hairs individually are plumbeous for the basal two-thirds, then narrowly annulated with fulvous and black — usually with two rings of fulvous and two of black, the tips of the hairs being either fulvous or black; ventral surface from lower throat to base of tail banded longitudinally with broad stripes of black and white, as follows: a median band of black about 10 mm. wide, with a broad band of white on either side of about the same width, and an outer band of black on either side, each about 8 mm. wide, all of equal length and approximately equal width; proximal half of the tail all around uniform with the back, or slightly more fulvous, the apical half black, varied with fulvous-tipped hairs at the extreme tip; limbs uniform with the upper surface, becoming gradually blackish on the feet and especially on the toes; ears small, rounded, pale rusty apically on the inner surface and blackish on the outer surface; no postocular spot; nose rather more fulvous than top of head.

Collector's measurements: Length, 17½ in. (445 mm.); tail, 8 in. (204 mm.); ear, 8 × 14 mm. (dry skin); hind foot, 48. The skull is unfortunately lacking.

This squirrel strikingly resembles the colored figure of *Sciurus quinquestriatus* Anderson (P. Z. S., 1871, pl. x), but this colored figure does not agree well with the accompanying description, nor with two specimens collected by Mr. Beebe in Upper Burma, not far from the type locality of *S. quinquestriatus*,— a remote and very different region climatically from the coast of southern Sarawak, Borneo.

Tamiops sauteri sp. nov.

Type, No. 31621, ♂, Chip Chip, Northern Formosa, November, 1908.

With three broad black dorsal stripes, the median one extending from the shoulders to the base of the tail, the outer ones shorter and broader, extending only from behind the shoulders to the hips; inner pair of light stripes nearly concolor with the general coloration of the nape and shoulders; outer pair of light stripes fulvous, paler than the corresponding stripes in *Tamiops leucotis* (Temm.) from the Malay Peninsula; general color of the upper parts mixed pale fulvous and gray, more gray on the nape and more strongly fulvous on the head; ears black, tufted with white; face markings as in *T. mcclellandii hainanus*; under parts fulvous gray; tail mixed black and ochraceous.

Head and body (in a well-made skin), 127 mm.; tail vertebræ, about 90.

Based on two skins from Chip Chip, northern Formosa, received with a good series of *T. mcclellandii formosanus* (Bonhote) from the same locality, collected also in November. *T. sauteri* differs from the latter in being smaller, with the upper parts much grayer and less fulvous, and in having three broad black dorsal stripes instead of only one. Named for Mr. H. Sauter, through whom the specimens were obtained.

The same collection also contained five specimens of *Heterosciurus,* two of which represent *H. thaiwanensis thaiwanensis* (Bonhote), one his *H. t. roberti,* while the other two approach his *H. t. centralis* in being chestnut below with a narrow median line of *gray,* instead of a "narrow strip of *chestnut* running from the inner side of each fore limb to the inner side of each corresponding hind limb." The two gray-bellied specimens are from Teraso, the other three from Chip Chip. Irregular blotches of dull chestnut on the ventral surface of one of the Teraso specimens, and the narrow gray median ventral line in two from Chip Chip seem to indicate intergradation between all three forms (all from Formosa), as implied by Mr. Bonhote's form of nomenclature.

59.9,82C

Article XIV.— THE GENERIC NAME CERCOPITHECUS.

By D. G. Elliot, D. Sc., F. R. S. E., etc.

For nearly a century and a half the genus *Cercopithecus* has been employed by all mammalogists for the group of African Monkeys known by the popular name of Guenon, and Erxleben, 1777, is usually given as the author of the generic term. On investigating the literature of this name, it would seem we must go farther back into the past than Erxleben, or even the twelfth edition of Linnæus's 'Systema Naturæ,' to learn that *Cercopithecus* when first employed as a genus had an American monkey for its type, and that no Guenon was included in it.

Distasteful as it is to the writer thus to overthrow long established custom, and restore *Cercopithecus* to its proper species, thus creating temporarily some confusion in two groups of the Primates, one of which is the largest known, no choice in the matter is left to him for the facts are too plain for any doubt to remain. These facts are as follows. Brisson in his 'Regnum Animale,' 1762, employed the genus Simiæ for all the monkeys known to him, but divided them into three subgeneric groups as follows: Simia with Simia sylvestris, the Ourang-utan, and *S. ceylonica*, a *Nycticebus*. The second subgenus is *Simia cynocephala*! with *S. cynocephala* an African baboon, and *S. cynocephala ceylonica*, also a *Nycticebus*. The third subgenus is *Papio*, with a single species, Le Babouin, probably *Simia cynocephala* Linnæus. The fourth subgenus is *Cercopithecus*, divided into two sections, "Stirps" IV, containing all the American monkeys known to him, and also some Old World species of different genera, and "Stirps" V, with three species, the first probably a *Papio*, and the next a *Pithecus*, the other *Simia sylvestris* Linn. There was no intention of making these "Stirps" genera or employing them as such, but they were used in the same way that subgeneric divisions are at the present time.

A year after Brisson's work was published, viz., 1763, Gronovius published his work 'Zoophylacium Gronovianum,' and on page 5 of the *Quadrupeda* he employs Brisson's subgenus *Cercopithecus* as a genus, citing it as "Stirps IV" of Brisson's work, naming as his first species, the "little black monkey" of Edwards's 'Natural History,' and giving the number of the colored plate 196. This is a very recognizable figure of the *Simia midas* Linnæus. Therefore, reluctant as we may be to accept the change, the Tamarins, or at least certain species of them, will have to be hereafter included in the genus *Cercopithecus*, which term was borne for so long a period by the Guenons. Gronovius names only one other form for *Cer-*

copithecus, the No. 6 of Linnæus' work, *Simia faunus,* which is quite undeterminable, thus leaving the *Simia midas* Linn., as the type. The generic term next in order to substitute for *Cercopithecus,* is *Lasiopyga* Illiger (Prodromus Systema Mammalium et Avium, 1811, p. 68), with *Simia nictitans* Linnæus as its type, and in this genus the Guenons must henceforth be included.

59.57,92D (7)

Article XV.—THE NORTH AMERICAN SPECIES OF *DRYOPHANTA* AND THEIR GALLS.

By William Beutenmüller.

Plates XII–XVII.

The present paper constitutes the tenth installment of a series of articles on North American Cynipidæ and their galls, published by me in this Bulletin.

Dryophanta bella (*Bassett*).

Cynips bella Bassett, Can. Ent., Vol. XIII, 1881, p. 93.

Dryophanta bella Mayr, Gen. Gallenb. Cynip., 1881, p. 36; Ashmead, Trans. Am. Ent. Soc., Vol. XII, 1885, p. 296; Dalla Torre, Cat. Hymen., Vol. II, 1893, p. 48; Mayr, Verh. Zool.-Bot. Gesell. Wien, Vol. XXXVI, 1886, p. 371; Vol. LII, 1902, p. 290; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 52.

Diplolepis bella Dalla Torre and Kieffer, Das Tierreich, pt. XXIV, 1910, p. 356.

Female: Head brownish black, very small, though transversely very broad. Vertex microscopically wrinkled. Eyes rather narrowly oval. Ocelli large, black and shining. Head and face covered with fine downy hairs. Antennæ short, slender, hairy, shining reddish brown, darker towards the tips, 14-jointed; first joint large, club-shaped or ovoid with the upper end truncate and hollow to receive the globular second joint; third joint one fourth longer than the first two taken together; fourth equal to the first and second; fifth to ninth gradually decreasing in length, tenth to fourteenth very short, scarcely longer than broad. Thorax covered with bright shining hairs. Anterior parallel lines extending from the collar three fourths the distance to the scutellum. Parapsidal grooves reaching from the scutellum to the collar. These are much nearer together at their starting point on the scutellum than is usual in the genus. There is the usual short line over the base of each wing. The posterior limit of the two parallel lines vanishes in a tuft of long hairs which, in common with the hairs on the thorax, converge into a ridge on each of the interlinear spaces. Scutellum small, but long in proportion to its breadth, slightly shagreened. Foveæ very shallow, confluent, smooth and shining. Legs dark shining, semi-translucent brown, with abundance of whitish hairs. Wings large, surface covered with short, nearly erect hairs, and numerous dark opaque and lighter cloudy spots. Veins dark shining brown and very heavy. Cubitus, as in *D. nubila*, is very broad and heavy at its union with the first transverse vein; second transverse broad and heavy, particularly at the base of the radial area. Areolet not large, but clearly defined. The radial vein at its termination forms a large triangular blotch with an indistinct areolet in the centre. By the curvature of the radial vein and its considerable backward extention along the margin of the wing and the upward extention of the costal vein beyond the base of the radial area, what may be termed a half open and perfectly radial area is formed. The anal vein is sometimes

branched or forked at the tip. Length, body 3.50 mm.; wings, 4 mm.; antennæ, 2 mm. (H. F. Bassett.)

Gall: (Plate XII, Figs. 1, 2, 3). On the under side of the leaves of a species of oak (probably *Quercus arizonica* Sarg.), often near the margin of the leaf, but more commonly on the mid-rib. Monothalamous. Round, thin-shelled and brittle with a central larval cell held in position by fine radiating fibres. There are also other fine, wooly fibres attached to the inner surface of the shell but which do not reach to the larval cell. The gall when dry is brown or pinkish brown, and covered with a fine pubescence or nearly smooth, but not polished. Diameter, 12–22 mm.

Habitat: Arizona (Tucson).

The gall of this species somewhat resembles that of *D. dugesi* but occurs singly on a leaf; when fresh is probably green or yellowish, tinged with pink. The fly is very distinct and may be readily known by the numerous small dots in the apical cell of the fore wings, the large brown patch in the radial area and discal cell. The male is unknown.

Dryophanta nubila (*Bassett*).

Cynips. q. nubila Bassett, Can. Ent., Vol. XIII, 1881, p. 56.

Dryophanta nubila, Mayr, Gen. Gallenb. Cynip., 1881, p. 36; Verh. Zool.-Bot. Gesell. Wien, Vol. XXXVI, 1886, p. 371; *ibid.*, Vol. LII, 1902, p. 290; Ashmead, Trans. Am. Ent. Soc., Vol. XII, 1885, p. 296; Dalla Torre, Cat. Hymen., Vol. II, 1893, p. 53; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 53.

Andricus nubila Ashmead, Trans. Am. Ent. Soc., Vol, XIV, 1887, p. 128.

Diplolepis quercus-nubila Dalla Torre and Kieffer, Das Tierreich, pt. XXIV, 1910, p. 358.

Female: Head very small, dark reddish brown. Vertex finely punctate or crackled. Ocelli shining, of medium size. Antennæ 13-jointed, slender, the base prominent; first joint tapering from its abruptly truncate summit; second joint short, ovoid; third one fourth longer than the two preceding taken together; fourth equal to the first and second; fifth to eighth gradually shorter; ninth to twelfth subequal; thirteenth slightly longer than the twelfth. The joints, particularly the third, fourth and fifth closely connected, but with a slight enlargement at the nodes in these last mentioned. Thorax very dark reddish or yellowish brown, in certain lights appearing blackish covered with very short appressed hairs, which give a slight ashen hue to the surface as seen with the naked eye. Two fine, smooth, rather indistinct anterior parallel lines extending half way from the collar to the scutellum, between these lines black. Parapsidal grooves distinct, extending from the collar, converging to the scutellum and increasing in size as they approach that point. Lateral grooves black. Scutellum distinctly wrinkled or rugose. Legs very dark reddish brown, somewhat shining and paler and subtranslucent at the joints. Wings very large, hyaline. Veins heavy, black. Areolet very small. Radial area open, broad. The base of the radial area covered with a dark semi-transparent cloud which includes the second transverse vein. Cubitus distinct and extending to the first transverse vein. At their intersection there is a dark cloudy spot, and a still larger ashen cloud near the tip of the wing. This last does not touch the veins nor

the margin of the wing. Abdomen very large and, viewed laterally, nearly circular in outline; first segment a little longer than the four following together. These last are subequal, and each of a deep yellowish brown on the posterior half, but lighter anteriorly. All the light bands, together with the lateral portions of all the segments, covered with minute microscopic hairs. Sheath of the ovipositor small, with a brush of rather long hairs at the apex. Length, body 3.75 mm.; wing, 5 mm.; antennæ, 3.25 mm.

Gall: (Plate XVI, Fig. 3). On the mid-vein on the under side of the leaves of a species of oak (probably *Quercus arizonica* Sarg.) in November. Bright pinkish red, densely hairy, in subglobular or hemispherical clusters. The galls in each cluster grow from the same point on the leaf, and the clusters are from one half to one inch in diameter, and contain from one to five or more larval cells. These cells, when denuded of their hairs, are nearly globular, tapering somewhat to a blunt point at the base, and measure from about 5 to 12 mm. in diameter. The inner galls are very hard and brittle when dry, and the shell is about .50 mm. thick.

Habitat: Arizona (Mule Pass Mts.).

The type is in the collection of the American Entomological Society. Nothing further is known concerning the species.

Dryophanta dugesi *Mayr.*

Dryophanta dugesi Mayr, Verh. Zool.-Bot. Gesell. Wien, Vol. XXXVI, 1886, p. 370; *ibid.*, Vol. LII, 1902, p. 290; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 52.

Dryophanta dugesii Dalla Torre, Cat. Hymen., Vol. II, 1893, p. 50.

Diplolepis dugesi Dalla Torre and Kieffer, Das. Tierreich, pt. XXIV, 1910, p. 355.

Female: Head reddish brown very finely rugose and moderately hairy. Antennæ 14-jointed, reddish brown, darker toward the tip. Thorax reddish brown, microscopically wrinkled, and with pits from each of which arises a short yellowish hair. Anterior parallel lines black, rather broad and polished. Parapsidal grooves deep, sharply defined and continuous. These grooves run obliquely from the collar to the scutellum where they are close together. Lateral grooves broad, long and running well forward, black and shining. Pleuræ very finely and evenly rugose with a large shining, smooth area. Scutellum finely rugose reddish brown, slightly hairy. Abdomen smooth reddish brown almost black posteriorly. Legs reddish brown and hairy. Wings glassy hyaline, transverse and radial veins dark brown, very heavy and margined with brown, other veins fine. Radial area open, first radial vein very short, the second curved and almost touching the costa. Areolet present. Cubitus continuous. In the apical cell are three brown dots, two small ones and one irregularly shaped larger one. Length, 2.10–3.10 mm.

Gall: (Plate XII, Figs. 6, 7). On the leaves of oak (*Quercus mexicana* = *Q. hypoleuca*). Monothalamous. Globular, very thin-shelled and pubescent, yellowish and beautifully shaded with pink or red, or finely marbled with red on the yellowish white surface. Inside there is a central egg-shaped larval cell which is held in position by numerous radiating delicate wool-like filaments somewhat like those of *D. bella*. Diameter, 6–18 mm.

Habitat: Mexico (Mts. of Guanajuanto).

Closely allied to *D. bella* but the thorax is more shining and the spots on the wings are different. The gall is also similar to that of *bella.* The above description of the fly was made from specimens in the United States National Museum, collected by Dr. A. Dugés and the figures of the galls on Plate XII are copies of Mayr's illustrations.

Dryophanta carolina *Ashmead.*

Dryophanta carolina Ashmead, Trans. Am. Ent. Soc., Vol. XIV, 1887, pp. 138, 145; Dalla Torre, Cat. Hymen., Vol. II, 1893, p. 49; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 52.

Diplolepis carolina Dalla Torre and Kieffer, Das Tierreich, pt. XXIV, 1910, p. 365.

Female: Head reddish brown, or somewhat darker along the middle of the face and very minutely rugoso-punctate. Antennæ 14-jointed, reddish brown and pubescent, thorax shining black, reddish brown along the parapsidal grooves, finely rugoso-punctate. Parapsidal grooves broad and distinct. Anterior parallel lines extending to a little beyond the middle of the thorax, very distinct and shining. Lateral grooves extending well forward, broad, smooth and polished. Scutellum rugoso-punctate, pubescent, basal groove broad and shallow. Abdomen reddish brown or black, smooth and shining, ventral sheath with long hairs. Legs reddish brown, pubescent. Wings hyaline, veins brown and heavy, radial vein thickened at the costa, second transverse vein infuscated. Radial area open. Cubitus continuous to first cross-vein.

Gall: (Plate XII, Fig. 4). On the under sides of the leaves of white oak (*Quercus alba*) in September and October. Monothalamous. Rounded or spherical, somewhat pubescent. The outer shell is hard; inside of a spongy substance with an internal larval chamber. Brownish in color, sometimes somewhat pruinose. Diameter, 5–6.

Habitat: North Carolina (Asheville); New York; New Jersey.

The gall very much resembles that of *Philonix niger,* in shape and structure, but is softer, less pubescent and smoother. The type form of the fly has the abdomen reddish brown.

Dryophanta multipunctata *Beutenmüller.*

Dryophanta multipunctata Beutenmüller, Ent. News, Vol. XXII, 1911, 67.

Female: Head yellowish brown, face broadly infuscated, eyes and ocelli black, microscopically evenly granulose and pubescent. Antennæ 14-jointed, first joint stout, second joint shorter, stout, third joint very long and slender, fourth to sixth joints slender, subequal and shorter than the third, remaining joints gradually becoming shorter and slightly thicker toward the tip, all pitchy brown black and pubescent. Thorax shining, finely and evenly pitted, with decumbent yellowish hairs, pitchy brown, somewhat rufous between the parapsidal grooves at the scutellum. Parapsidal grooves rather deep, widely separated anteriorly and converging

at the scutellum, where they are moderately widely separated. Anterior parallel lines very fine and indistinct. Lateral grooves distinct. Median groove wanting. Scutellum pitchy brown somewhat rufous, finely and evenly pitted with yellowish hairs, basal groove not distinct. Abdomen pitchy black or dull rufous, smooth and shining dorsally and covered with short pale hairs at the sides and venter. Legs pitchy brown or dull yellowish brown, pubescent. Wings hyaline, veins brown, cross-veins heavy, outer portion of wing beyond the middle with numerous small brown spots, except in the radial area; about the middle of the wings are two brown clouds situated on the veins. Areolet present. Cubitus extending to the first cross-vein. Length, 2.75–3 mm.

Gall: (Plate XII, Fig. 5). On the under side of the leaves of a species of white oak in autumn. Monothalamous. Spherical, gray brown, sometimes slightly flattened at the base where the gall is attached to the leaf. It is irregularly wrinkled and covered with dense, short and compact wooly substance and hairs. In general appearance it resembles the gall of *Philonix lanæglobulæ*. Diameter about 5 mm.

Habitat: California (Kern Co.).

The fly resembles that of *Dryophanta clavula,* but differs in having the abdomen hairy and more spots on the outer part of the fore wings.

Dryophanta clavula *Beutenmüller.*

Dryophanta clavula Beutenmüller, Ent. News, Vol. XXII, 1911, p. 67.

Female: Head rufous, infuscated along the face and on the vertex around the ocelli, evenly and finely reticulately punctate, sparsely hairy; eyes black. Antennæ 14-jointed, first joint stout, short, second joint much smaller and stout; third to sixth joints long and slender, third longest, remaining joints short and subequal, all dusky brown somewhat darker toward the tip. Thorax pitchy brown, rufous posteriorly and anteriorly at the sides, microscopically pitted especially anteriorly, shining and with scattered decumbent yellowish hairs. Parapsidal grooves deep and distinct, widely separated anteriorly and running obliquely backward to the scutellum where they are close together. Median groove wanting. Anterior parallel lines broad, shining smooth and scarcely extending to the middle of the thorax. Grooves at base of wing scarcely evident. Scutellum rugose, subopaque, dull rufous, finely and evenly rugose with an almost imperceptible basal groove. Abdomen pitchy brown somewhat rufous ventrally, smooth and shining, sheath yellowish with long hairs. Legs dull yellowish brown covered with short hairs. Wings hyaline, pubescent, veins brown, heavily marked, especially the cross-veins, apical region with about seven small brown dots and a large brown patch; three large brown clouds about the middle of the wing. Radial area almost closed with the veins thickened at the costa. Areolet present. Cubitus faint and extending to the first cross-vein. Length, 1.50–2 mm.

Gall: (Plate XIII, Fig. 7). On the under side of the leaves of a species of white oak (*Quercus lobata*). Monothalamous. Narrow and almost parallel to about the middle, thence suddenly becoming inflated into club with the apex pointed. At the extreme base it is slightly broader and is attached by a point to the leaf. The gall very much resembles a miniature Indian club in shape. Brown in color (when dry) and the larva lives in the inflated part of the gall in a round cell. Length, 5–7 mm.; width of narrow part, 1 mm.; of inflated part, 1.75 mm.

Habitat: California (Napa and Sonoma Co.).

Dryophanta eburnea *Bassett.*

Dryophanta eburneus Bassett, Trans. Am. Ent. Soc., Vol. XVII, 1890, p. 70; Beutenmüller, Bull. Am. Mus. Nat. Hist., Vol. XXIII, 1907, p. 466.

Dryophanta eburnea Dalla Torre, Cat. Hymen., Vol. II, 1893, p. 50; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 52.

Diplolepis eburnea Dalla Torre and Kieffer, Das Tierreich, pt. XXIV, 1910, p. 368.

Dryophanta glabra Gillette, Can. Ent., Vol. XXVI, 1894, p. 237; Dalla Torre, Cat. Hymen., Vol. II, 1893, p. 52; Cockerell, Can. Ent., Vol. XXXII, 1900, p. 92; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 52.

Diplolepis glabra Dalla Torre and Kieffer, Das Tierreich, pt. XXIV, 1910, p. 367.

Female: Head black, finely punctate, with a few minute hairs, sometimes narrowly dark rufous around the eyes. Antennæ 14-jointed, black, short and rather stout, first joint thick, second less so and two thirds as long, third as long as the two preceding taken together, fourth half as long as the third, remaining ones short, all with minute hairs. Thorax black, smooth and shining. Parapsidal grooves deep, microscopically rugoso-punctate and with a few scattered hairs on each side. Pleuræ finely rugose with a polished area. Scutellum sub-opaque, finely rugose as is also the depression at the base. Abdomen black and shining. Legs blackish brown with reddish brown joints. Wings hyaline, pubescent, veins brown, moderately heavy. Radial area long, open. Areolet very small. Cubitus very faint and almost colorless the entire length to the first cross-vein. Length, 1.50–2.50 mm.

Gall: (Plate XVI, Figs. 1, 2). In number on the upper and under side of the leaves of oak (*Quercus undulata* and *Q. gambelii*) in August and September. Monothalamous. Straw-colored, becoming brown with exposure. Semi-globular, flatted at the base and as a rule situated along the mid-rib. A number of the galls usually occur on the same leaf and sometimes closely pressed together, so they are far from globular. The outer shell is rather hard and thick and inside are filled with fine silvery white hairs that radiate from the single larval cell that is attached to the base of the gall.

Habitat: Southern Utah; Arizona; Colorado (Manitou).

The type of *D. eburnea* Bassett is from Southern Utah, and of *D. glabra* from Manitou, Colorado. The latter is identical with *D. eburnea*, there being absolutely no differences between the flies and galls.

Dryophanta simillima *Dalla Torre.*

Dryophanta similis Bassett, Trans. Am. Ent. Soc., Vol. XVII, 1890, p. 71.

Dryophanta simillima Dalla Torre, Cat. Hymen., Vol. II, 1893, p. 54; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 53.

Diplolepis simillima Dalla Torre and Kieffer, Das Tierreich, pt. XXIV, 1910, p. 368.

According to H. F. Bassett, this species resembles *Dryophanta eburnea*, but is much smaller, the body being only 1.50 mm., the wing 3 mm., and the antennæ 1.75

mm. in length, and the cubital vein in the lower half is subobsolete. The gall is also similar to that of *D. eburnea* in all respects, save color, which is a shining brownish buff.

Habitat: Southern Utah.

The types are with the American Entomological Society. They are exactly like *D. eburnea*, except in size. I consider the species small specimens of *D. eburnea*. The name *D. similis* Bassett was preoccupied by *D. similis* Alder of Europe, and changed to *D. simillima* by Dalla Torre.

Dryophanta polita (*Bassett*).

Cynips polita Bassett, Can. Ent., Vol. XIII, 1881, p. 99.

Dryophanta polita Mayr, Gen. Gallenb. Cynip., 1881, p. 36; Verh. Zool.-Bot. Gesell. Wien, Vol. XXXVI, 1886, p. 371; *ibid.*, Vol. 411, 1902, p. 290; Ashmead, Trans. Am. Ent. Soc., Vol. XII, 1885, p. 296; *ibid.*, Vol. XIV, 1887, pp. 127, 135; Dalla Torre, Cat. Hymen., Vol. II, 1893, p. 53; Beutenmüller, Bull. Am. Mus. Nat. Hist., Vol. IV, 1892, p. 261, pl. XII, fig. 3; Am. Mus. Journ., Vol. IV, 1904, p. 106, fig. 39; Ins. Galls Vicin. N. Y., 1904, p. 20, fig. 39; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 53; Felt, Ins. Affect. Pk. and Woodl. Trees, 1906, p. 625.

Diplolepis polita Dalla Torre and Kieffer, Das Tierreich, pt. XXIV, 1910, p. 366.

Female: Head brownish black or rufous, finely and evenly punctate, particularly the vertex. Antennæ 14-jointed, blackish or dark rufous. Thorax black, smooth and highly polished. Parapsidal grooves deep and distinct. Anterior parallel lines short and indistinct. Lateral grooves long and shallow. Pleuræ rugulose with a large, polished area and with a few scattered hairs. Scutellum finely wrinkled, rounded posteriorly; basal groove narrow. Abdomen black, polished. Legs reddish brown. Wings glassy hyaline, veins moderately heavy. Radial area open, broad by the curvature of the vein. Areolet present. Cubitus very pale and slender. Length, 2.50 mm., wings, 3.50 mm.

Gall: (Plate XIII, Figs. 1, 2, 3). On the upper and under side of the leaves of post oak (*Quercus minor*) August and September into October. Monothalamous. Bright yellow, sometimes more or less tinged with red. Brown when old and dry. Round, thin shelled containing a central larval cell held in position by radiating fibres. Single or in clusters. Diameter, 10–15 mm.

Habitat: New York; New Jersey; southward into Florida and Texas.

The gall in general appearance very much resembles that of *Andricus singularis*, and occurs singly on red oak in spring. The insect may be readily known by the highly polished thorax and glassy wings. The gall is quite local, and hundreds of them may be found on young shoots and young trees. The insect matures late in autumn but does not emerge until the following spring. In the vicinity of New York the gall is found in the sandy pine regions of New Jersey.

Dryophanta lanata *Gillette.*

Dryophanta lanata Gillette, Bull. Ill. Lab. Nat. Hist., Vol. III, 1891, p. 198, pl. ix, fig. 5; Dalla Torre, Cat. Hymen., Vol. II, 1893, p. 52; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 52.

Diplolepis lanata Dalla Torre and Kieffer, Das Tierreich, pt. XXIV, 1910, p. 363.

Female: Face scabrous, shining, with very few hairs; vertex black, subopaque, finely and densely sculptured; ocelli considerably elevated, clypeus polished, emarginate, punctured. Antennæ black, 14-jointed (in one specimen 13-jointed) a trifle over 2 mm. in length; joints 1 and 2 stout, the latter subglobular, joint 3 one third longer than joint 4, last joint scarcely longer than the preceding. Thorax: mesothorax covered with a fine network of depressed lines leaving irregular raised portions that are highly polished, parapsidal grooves narrow but well defined, polished at the bottom and reaching the collar, median groove showing plainly at the scutellum but soon disappearing as it runs forward; the two parallel grooves from the collar narrow at first, then spreading out in broad furrows with sloping sides, traceable about one third of the way to the scutellum; lateral grooves plainly marked, extending well forward, and approximating the parapsides at their anterior extremity; pleuræ finely aciculate and shining. Scutellum bifoveate, the foveæ shallow, separated, not by a septum, but by a number of polished raised lines that run into the smooth surfaces of the bottoms of the foveæ; lateral borders of the scutellum strongly aciculate anteriorly, the lines becoming crooked and broken posteriorly and forming a densely and deeply rugose surface; scutellum black at base and tip and rufous in the middle. Abdomen dark rufous to black, second segment occupying one half of tergum, posterior half of the second segment and all of the following segments rather densely punctured, all of the segments highly polished. Wings hyaline, rather densely ciliate, 4 mm. long, submedian and 1st and 2nd transverse nervures stout and black, areolet medium. Length, 3.50–4 mm. (C. P. Gillette.)

Gall: (Plate XIV, Figs. 1, 2, 3). On the undersides of the leaves of red oak (*Quercus rubra*), scarlet oak (*Quercus coccinea*), black oak (*Quercus velutina*), blackjack oak (*Quercus marylandica*), hybrid oak (*Quercus phellos* × *Quercus marylandica* = *rudkini* Brit.), and scrub oak (*Quercus nana*), in August, September and early in October in clusters of from two to eight or more, appearing externally as bunches of pale brown wool, somewhat resembling the gall of *Callirhytis flocci*. Each individual gall when denuded of its wool, is triangular or irregularly conical in shape and when fresh is fleshy and rather soft. They are closely pressed together and form a rounded mass of wool, showing the outlines of the individual galls. When mature they are hard and woody with a large internal larval chamber. The pointed part of the gall is attached to the leaf. Diameter, 5–15 mm.

Habitat: Canada (Toronto); Massachusetts; Rhode Island; Connecticut; New York; New Jersey; Pennsylvania; Ohio; Illinois; Iowa.

This species was described from two females bred from galls taken at Ames, Iowa. I have taken hundreds of the galls, but have not succeeded in rearing the flies. According to C. P. Gillette this is a robust, black species, with more or less rufous on face, mesonotum, scutellum, and sides

of abdomen. The galls drop to the ground late in September and early in October and the larva reaches maturity after the galls have fallen.

Dryophanta echinus (*Osten Sacken*).

Cynips quercus echinus Osten Sacken, Trans. Am. Ent. Soc., Vol. III, 1870, p. 56.

Cynips echinus Ashmead, Trans. Am. Ent. Soc., Vol. XII, 1885, p. 295; Dalla Torre, Cat. Hymen., Vol. II, 1893, p. 68; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 59; Das Tierreich, pt. XXIV, 1910, p. 440.

Andricus speciosus Bassett, Trans. Am. Ent. Soc., Vol. XVII, 1890, p. 81; Dalla Torre, Cat. Hymen., Vol. II, 1893, p. 101; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 65.

Dryophanta speciosa Mayr, Verh. Zool.-Bot. Gesell. Wien, Vol. LII, 1902, p. 290.

Diplolepis speciosa Dalla Torre and Kieffer, Das Tierreich, pt. XXIV, 1910, p. 368.

Female: Head dark brown, reddish around the eyes, finely rugose; cheeks with a furrow. Antennæ 14-jointed, first and second joints subequal, third joint very long, slender, fourth joint shorter, remaining joints shorter, all brownish black. Thorax brownish black, slightly tinged with rufous, and sparsely covered with minute hairs, surface minutely reticulated. Parapsidal grooves deep and rapidly converging toward the scutellum. Anterior parallel lines broad, smooth and extending to about the middle of the thorax. Lateral grooves broad, extending well forward and almost touching the parapsidal grooves. Scutellum deep brown black, finely rugose, slightly hairy, basal groove distinct, somewhat shining. Abdomen brown black with short hairs on the sides of the base. Legs dark reddish brown, pubescent. Wings hyaline, veins heavy and brown, second transverse vein angulated and infuscated, first transverse also infuscated. Cubitus fine and continuous. Radial area open. A large brown spot near the base of the marginal cell (apical) and one in the submarginal cell. Length of body, 2–3 mm.; wings, 2–3.50 mm.

Gall: (Plate XIII, Fig. 6). On the under side of the leaves of *Quercus agrifolia*). Sometimes also on the upper side. Monothalamous. Rounded and covered with many pointed processes which are not much shorter than the diameter of the gall. Bright red or pinkish and covered with a crystalline substance. Inside the gall is hard (when dry) and contains a single cell in the centre. Diameter, 5–8 mm.

Habitat: California (Placer and Napa Counties).

I have examined the types of the flies and galls of *Cynips echinus* and *Dryophanta speciosa* and find them to be one and the same species.

Dryophanta rubræ (*Karsch*).

Diplolepis quercus rubræ Karsch, Zeitsch. Gesammt. Naturw. Berlin, Bd. V, 1880, p. 293, figs. 4, 4a, 4b,; Mayr, Verh. Zool.-Bot. Gesell. Wien, Vol. XXXVI, 1886, p. 369; Dalla Torre and Kieffer, Das Tierreich, pt. XXIV, 1910.

Dryophanta rubræ Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 53.

Female: Body, antennæ and legs brown. Body covered with fine, short, yellowish brown hairs, giving the dark insect a light appearance. Antennæ 14-jointed, and not thickened at the tip. Scutellum rounded behind and with long hairs at the apex. Parapsidal grooves and foveæ at the base of the scutellum readily discernible when seen under a lens. First abdominal segment drawn out into a point and beset with strong hairs. Wings (Plate XIII, Fig. 5) very characteristic; the radial area is not entirely closed and in the outer cubital cell is a zigzag mark near the outer margin, of a dark brown color. Veins dark brown. Cubitus not extending to the first cross-vein. Length, 4 mm. Expanse of wings about 10 mm.

Gall: (Plate XIII, Fig. 4). On red oak (*Quercus rubra*). Globular, very thin-shelled and flatted at place of attachment. Yellowish with irregular reddish brown marks, base whitish. Inside is an irregularly shaped larval cell held in position by radiating fine yellowish fibres. Diameter about 20 mm.

Habitat: North America (without definite locality, probably Texas).

The types, two females and two galls, are in the Berlin Museum, and the species is unknown to me. The above are translations of Karsch's description of the flies and galls. The specimens were received from Van Zandt on "*Quercus rubra.*" The figures of the gall and wing of the fly on Plate XIII, were re-drawn from Karsch's illustrations.

Dryophanta centricola (*Osten Sacken*).

Dryophanta centricola Mayr, Verh. Zool.-Bot. Gesell. Wien, Vol. LII, 1902, p. 290.
Diplolepis quercus-centricola Dalla Torre and Kieffer, Das Tierreich, pt. XXIV, 1910, p. 369.

This species was transferred from the genus *Holcaspis* to *Dryophanta* by Mayr in 1902, and an account of the same will be found in my paper on the species of *Holcaspis* and their Galls (Bull. Am. Mus. Nat. Hist., Vol. XXVI, 1909, p. 42, pl. ix, fig. 1).

Dryophanta douglasi (*Ashmead*).

Dryophanta douglasi Mayr, Verh. Zool.-bot. Gesell. Wien, Vol. LII, 1902, p. 290,
Diplolepis douglasi Dalla Torre and Kieffer, Das Tierreich, pt. XXIV, 1910. p. 369.

Mayr placed this species in the genus *Dryophanta* and an account of the insect and gall will be found in my paper on the species of *Holcaspis* and their Galls (Bull. Am. Mus. Nat. Hist., Vol. XXVI, 1909, p. 37, pl. viii, figs. 10, 11). It was originally described as a *Holcaspis*.

Dryophanta corrugis *Bassett.*

Dryophanta corrugis Bassett, Trans. Am. Ent. Soc., Vol. XVII, 1890, p. 71; Dalla Torre, Cat. Hymen., Vol. II, 1893, p. 49; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 52.

Diplolepis corrugis Dalla Torre and Kieffer, Das Tierreich, pt. XXIV, 1910, p. 363.

Female: Head black or pitchy brown black with extremely fine reticulations. Antennæ thick, short, becoming stouter toward apex, 14-jointed, first heavy, club-shaped; second thicker than the first and almost equal in length, third two-thirds as long as the first two and extremely slender, all light yellowish brown; fifth yellowish to dark brown at the tip, a little thicker than the fourth; remaining joints very dark brown, very short and thick, the thirteenth and fourteenth separated by an indistinct articulation, and the thirteenth not so dark brown as the preceding. Thorax black, narrow, subopaque; anterior parallel lines present, parapsidal grooves narrow not extending to the anterior part of thorax; all grooves are quite slender and indistinct. General surface of the mesonotum finely, evenly and very beautifully transversely wrinkled. Pleuræ finely rugose. Scutellum black, rather large, more finely wrinkled than the mesonotum and less shining with a transverse depression at base. Abdomen dark reddish brown black posteriorly or wholly black, polished, subdepressed, second segment rather long, third half as long as the second, others concealed in the dry specimens. Legs: femur and tibia dark brown, except the joints which with the coxæ and tarsi are yellowish-brown, ungues simple. Wings hyaline, veins pale yellow, almost colorless. Areolet very faint or wanting. Cubitus so indistinct as to be traced with difficulty even half way to the first transverse vein. Radial area large, almost closed; first transverse does not reach quite to the anterior edge of the wing. Length of body, 2.50 mm.; wings, 2.50 mm.; antennæ, 2 mm.

Habitat: Connecticut (Waterbury).

The flies of this species were captured by H. F. Bassett while in the act of ovipositing in the buds of dwarf chestnut oak (*Quercus prinoides*) in spring. The gall is not known.

Dryophanta texana *Ashmead.*

Dryophanta texana Ashmead, Trans. Am. Ent. Soc., Vol. XIV, 1887, p. 145; Dalla Torre, Cat. Hymen., Vol. II, 1893, p. 54; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 53.

Diplolepis texana Dalla Torre and Kieffer, Das Tierreich, pt. XXIV, 1910, p. 357.

Female: Head and thorax black, antennæ, legs (including the coxæ) and abdomen brownish red, first two joints of antennæ brownish yellow, head finely punctate, ocelli large. Antennæ 14-jointed, reaching to the tip of the scutellum. Thorax smooth, shining with two parapsidal grooves. Pleuræ and metathorax rugose, the disk of mesopleuræ smooth and polished. Scutellum large, rugoso-punctate, projecting over the metathorax. Wings hyaline, veins stout, black, marginal nervure greatly incrassated towards the tip which does not reach the costal margin; second transverse vein in a smoky cloud. Areolet present, cubitus continuous. A smoky

cloud at the break in the anal nervure and the thickened cubital nervure does not quite reach the apical margin. Radial area open. Length, 4.25 mm.

Habitat: Texas.

Described from a single female, the type of which is in the United States National Museum. It is a fine species and may be known by the black head and thorax and the red abdomen. The male and gall are unknown.

Dryophanta pumiliventris *Bassett.*

Dryophanta pumiliventris Bassett, Trans. Am. Ent. Soc., Vol. XVII, 1890, p. 69; Dalla Torre, Cat. Hymen., Vol. II, 1893, p. 54; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam Cynip., 1902, p. 53; Das Tierreich, pt. XXIV, 1910, p, 361.

Male: Head yellowish brown; ocelli pale yellow; vertex and face somewhat rugose, face with a distinct median ridge, cheeks grooved. Antennæ 15-jointed, very long and slender, third joint very long and slightly curved, following joints shorter and subequal. Thorax narrow, smooth and shining, yellowish brown. Parapsidal grooves deep. Pleuræ slightly darker, shining. Scutellum finely rugose, opaque, basal depression very shallow and slightly shining. Abdomen very small, yellowish brown, and on a peduncle. Legs long, brown. Wings hyaline somewhat dusky, very long, veins brown. Radial area open. Areolet present. Cubitus almost colorless. Length of body, 3 mm.; abdomen, 1.25 mm.

Habitat: Not known (probably Connecticut).

This species was bred by H. F. Bassett from galls sent to him through the mail. He states that the galls are probably green, soft and succulent, growing in clusters in the axils leaves and when fresh may have been as large as a chestnut or hazel nut. They seem to vary in size and form and are polythalamous. Bassett's galls were shrunken and distorted and a good discription was impossible from the material he had at hand. The female is unknown.

Dryophanta radicola *Ashmead.*

Dryophanta radicola Ashmead, Proc. U. S. Nat. Mus., Vol. XIX, 1893, p. 116; Bridwell, Trans. Kans. Acad. Sci., Vol. XVI, 1899, p. 204; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 53; Das Tierreich, pt. XXIX, 1910, p. 360; Cook, Proc. Ind. Acad. Sci., 1904, p. 225; 29th Rep. Dept. Geol. Nat. Hist. Indiana, 1904 (1905), p. 360, fig. 29.

Female: Brick red, antennæ pale brownish toward tips; eyes brown-black. Head minutely and confluently punctate; collar rugose; disk of mesopleura smooth, polished; mesonotum smooth, polished, the two parapsidal grooves broad and well defined; scutellum cushion-shaped, coarsely, reticulately rugose, with two transverse, nearly confluent, foveæ at base. Wings hyaline, veins blackish, the areolet and cubital cell distinct. Length, 3 mm.

Gall: (Plate XV, Figs. 9, 10). In clusters on the stems of white oak (*Quercus alba*) and post oak (*Quercus minor*), just below the surface of the ground. Polythalamous. Fig-shaped, yellow, and when partly exposed to the sun becomes bright red.

Habitat: New York; Missouri (Cadet); Kansas; Indiana; Texas.

According to W. H. Ashmead the gall of this species was found on the roots of oak collected at Cadet, Missouri.

Dr. Mel. T. Cook found the gall in Indiana on white oak and the figures on Plate XV, are copies from his illustrations. The adult was described from a single female, reared May 21, 1886.

Dryophanta pulchella *Beutenmüller.*

Dryophanta pulchella Beutenmüller, Ent. News, Vol. XXII, 1911, p. 357.

Female.— Head rufous or pitchy brown, finely punctate, median ridge rather broad. Antennæ 14-jointed, dark brown, first and second joints yellowish brown. Thorax dark reddish brown or black, smooth and shining. Parapsidal grooves sharply defined with the margins rounded; they are widely separated anteriorly and very close together at the scutellum. Median groove broad anteriorly and gradually becoming narrower and very fine at the scutellum. Anterior parallel lines and lateral grooves wanting. Pleuræ punctate with a large, smooth, glossy area. Scutellum dark rufous or black, rugose, with two large depressions or foveæ at the base, separated by a fine carina. Abdomen rufous, smooth and shining. Legs rufous. Wing long, hyaline with a number of large brown clouds and patches of different sizes. Veins heavy, brown and infuscated. Areolet small, cubitus continuous to the first cross-vein. Radial area open, radial vein curved and running outwardly for a short distance below the costal margin. Length, 3–3.50 mm.

Habitat: Catalina Island, California (C. F. Baker); Hood River, Oregon, June 20.

In the specimen from Oregon the thorax is black, otherwise it does not differ from the form with the red thorax. It is a beautiful species and may be readily known by the large spots and cloud on the fore wings. The male and gall are unknown.

Dryophanta rydbergiana *Cockerell.*

Dryophanta rydbergiana Cockerell, Can. Ent., Vol. XXXV, 1903, p. 217.

Diplolepis rydbergiana Dalla Torre and Kieffer, Das Tierreich, pt. XXIV, 1910, p. 370.

Female: Body 2.50 mm. long, stout, jet black, smooth, neither punctured nor conspicuously hairy; mesothorax and scutellum with a few scattered hairs; front and vertex minutely tessellate; no frontal groove; middle ocellus somewhat depressed, face without carinæ; molar space long, wrinkled; flagellum black, 12-jointed; the last five joints (at least) longitudinally grooved; whole flagellum hairy; first flagellar

joint about one-fourth longer than second; basal of antennæ dark red; the small first joint punctate. Parapsidal grooves deep and strong, completely converging posteriorly; scutellum large and swollen, longitudinally keeled, with a depression on each side anteriorly; anterior margin of scutellum raised into a sharp ridge; posterior part coarsely cancellate. Mesothoracic ridges very widely candad. Legs red; tarsi hairy; claws of posterior legs simple; wings hyaline, not spotted, but hairy; veins strongly marked with dark brown; marginal cell not quite attaining costa; areolet present. Ovipositor black; concealed; ventral spine red, covered with long ferruginous hairs. (T. D. A. Cockerell.)

Gall: On the leaf of *Quercus rydbergiana*. Monothalamous. Spherical, faintly shining, light ferruginous, with a microscopically tessellate surface and a scattered stellate pubescence; base concave, point of attachment small. Contains a single large cell; the space between the cell and the exterior filled with a spongy tissue, which is light green within and ferruginous outwardly. Diameter, 6 mm.

Habitat: Las Vegas Hot Springs, New Mexico, about 7000 feet.

Described from a single specimen cut from a gall which was found March 31, 1903, on a leaf of the previous year's growth. Prof. Cockerell places this species in the genus *Dryophanta*, because it seems on the whole to go there best, and states that it does not exactly agree with any described American genus. Nothing further concerning the species is known and we do not know where the type is.

Dryophanta emoryi *Ashmead.*

Dryophanta emoryi Ashmead, Proc. U. S. Nat. Mus., Vol. XIX, 1896, p. 115; Cockerell, Trans. Kans. Acad. Sci., Vol. XVI, 1899, p. 213; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 52.

Diplolepis emoryi Dalla Torre and Kieffer, Das Tierreich, pt. XXIV, 1910, p. 367.

Female: Form rather slender, polished black; antennæ and legs dark brown, almost black, the articulations and tarsi dark honey yellow or slightly reddish. The head and thorax are covered with long sparse pile; lower part of face with some coarse punctures, and a poorly defined median ridge. The antennæ extend to the base of the abdomen, pubescent, 14-jointed, the third joint more than one third longer than the fourth; flagellar joints three, four, five and six are rounded at apex; the others are short, slightly widened and truncate at apex, but narrowed and rounded at base; the terminal joint one third longer than the preceding, fusiform. The thorax has two broad, distinct, parapsidal grooves; scutellum minutely rugose, elevated and rounded posteriorly, but with a small, smooth, shining spot on the disk; at base it is transversely depressed and apparently without the usual foveæ; if they exist they are small. The mesopleura are smooth, shining, but when carefully examined a few striæ can be detected anteriorly and basally. The abdomen is large, polished, longer than the head and thorax together, compressed, and, when viewed from the side, obovate in outline; the ventral valve projects considerably, and is armed and hairy. Legs rather densely pubescent. Wings long, hyaline, pubescent, the veins strongly developed, dark brown, slightly piceous. Length, 2 mm. (W. H. Ashmead).

Gall: (Plate XIV, Figs. 4, 5, 6, 7). In clusters on the under surface of the leaves of oak (*Quercus emoryi*). Monothalamous. Brown, thin-shelled, semiglobular or almost globular and attached by a small point to the leaf. Internally there is a small, central kernel, held in place by delicate hair-like fibers. Diameter, 2–3.50 mm.

Habitat: New Mexico (Silver City); Mexico (Tatilla), Sept.

In specimens from Tatilla, Mexico, received from Prof. A. D. Hopkins, the head is reddish brown, the anterior parallel lines and lateral grooves of the thorax are wanting, and the parapsidal grooves are sharply defined. The second transverse vein is infuscated and the radial area is open, that is the first vein scarcely touches the costa.

Dryophanta pulchripennis *Ashmead.*

Dryophanta pulchripennis Ashmead, Proc. U. S. Nat. Mus., Vol. XIX, 1896, p. 115; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 53.

Diplolepis pulchripennis Dalla Torre and Kieffer, Das Tierreich, pt. XXIV, 1910, p. 357.

Dryophanta porteræ Cockerell, Can. Ent., Vol. XXXII, 1900, p. 32.

Diplolepis posteræ Dalla Torre and Kieffer, Das Tierreich, pt. XXIV, 1910, p. 367.

Female: Brownish yellow, the second abdominal segment apically dark brown. In one of the two specimens in the collection, the mesonotum, scutellum, and metathorax are brownish; eyes, ocelli and ungues dark brown. Head, thorax and pleura smooth, shining; the head much wider than the thorax and thick antero-posteriorly. Antennæ about as in *D. emoryi*, the fourteenth joint, however, not being distinctly separated from the thirteenth, connate. Mesonotum short, nearly as broad as long, with two parapsidal grooves, but not as distinct as usual in the genus. Abdomen as long as the head and thorax together, compressed when viewed from the side, truncate behind; the ventral valve projects very considerably and is armed with an unusually long, hairy spine, half the length of hind femur. Wings hyaline, the front wings being beautifully clouded or spotted with brown blotches as follows: A blotch in the cubital cell near the basal vein, one at the break in the anal vein, one in the cell formed by this vein and the branch of the cubitus which extends to the apical margin, and in the space known as the second submarginal cell are two blotches, one near the apex, the other at the base, the last inclosing the whole tip of the radius. Veins brown, the radius slightly thickened at tip: the vein at base of radial cell slightly clouded. Length, 1.8–2 mm. (W. H. Ashmead.)

Gall: (Plate XIV, Fig. 8). In numbers on the under side of the leaves of oak (*Quercus undulata*). Almost hemispherical, pale brown, subopaque, reticulate, and with scattered, very minute, reddish tubercles, which have some white hairs basally. Diameter about 3 mm.

Habitat: Arizona; New Mexico (Las Vegas Hot Springs), January.

The type of the fly of *D. porteræ* is in the United States National Museum and it does not differ from *D. pulchripennis*. The gall of *D. pulchripennis* very much resembles that of *D. emoryi* but the former is more

convex. The fly may be readily known by the brown blotches and clouds on the forewings, which are wanting in *D. emoryi.* The gall of *D. porteræ,* according to T. D. A. Cockerell, occurs on leaves of *Q. undulata,* and judging from the shape of the leaf, *D. pulchripennis* is found on *Quercus chrysolepidis.*

Dryophanta gemula (*Bassett*).

Cynips gemula Bassett, Can. Ent., Vol. XIII, 1881, p. 104.

Dryophanta gemmula Mayr, Gen. Gallenb. Cynip., 1881, p. 36; Verh. Zool.-Bot. Gesell. Wien. Vol. XXXVI, 1886, p. 371; Ashmead, Trans. Am. Ent. Soc., Vol. XII, 1885, p. 296; Dalla Torre, Cat. Hymen., Vol. II, 1893, p. 52; Dalla Torre and Kieffer, Gen. Ins. Hymen, Fam. Cynip., 1902, p. 52.

Dryophanta gemula Ashmead, Trans. Am. Ent. Soc., Vol. XIV, 1887, p. 131.

Diplolepis gemmula Dalla Torre and Kieffer, Das Tierreich, pt. XXIV, 1910, p. 359.

Female: Head black, very finely and minutely rugose. Antennæ 14-jointed, first and second joints pale yellowish brown, the remaining joints brown, becoming darker terminally. Thorax black, shining and microscopically wrinkled, under a high power lens (smooth to the naked eye). Parapsidal grooves well defined, rather deep. Anterior parallel lines and lateral grooves scarcely evident. Mesopleura shining, the other minutely rugose. Scutellum black, finely rugose with a few microscopic hairs; basal groove narrow. Abdomen shining black or pitchy brown black. Legs uniform clear yellow, claws black. Wings hyaline, somewhat dusky. Veins well-defined and dark. Cubitus extending to the first cross-vein. Radial area slightly open. Areolet present and rather well defined. Length, 1.75–2 mm.

Male: Antennæ 15-jointed, first and second joints darker than in the female, third joint slightly curved. Thorax narrow. Wings longer. Abdomen very small and compressed laterally. Color as in the female. Length, 2–2.25 mm.

Gall: (Plate XVI, Figs. 11, 12). Singly in the center of both the flowering and leaf buds of dwarf chestnut oak (*Quercus prinoides*) early in May. Monothalamous. Rounded or oval, sometimes pointed at the apex, thin shelled, containing no larval chamber; it is usually hidden in the surrounding bud and difficult to detect. Blackish in color. Length, 2.50 mm.; diameter, 1.25 mm.

Habitat: Connecticut (Waterbury); New Jersey (Lakehurst).

Dryophanta pallipes *Bassett.*

Dryophanta pallipes Bassett, Trans. Am. Ent. Soc., Vol. XXVI, 1900, p. 327; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 53.

Diplolepis pallipes Dalla Torre and Kieffer, Das Tierreich, pt. XXIV, 1910, p. 358.

Male: Body black. Head finely wrinkled, wider than the thorax. Antennæ 15-jointed, first joint smaller than the second, club-shaped, second globose, both pale, third to the fifteenth changing gradually from pale to dark dusky brown. Thorax black. Parapsides very distinct, closely converging at the scutellum. The space between these lines is polished and smooth and outside finely punctate. Scutellum rather coarsely rugose; foveæ wanting. Abdomen petiolate, compressed,

shining black. Legs very pale brownish yellow. Wings sub-fuscous; veins heavy, reddish brown. Radial vein heavy and ending very abruptly within the margin of the wing. Areolet distinct. Cubitus heavy, reaching the first transverse.

Females: The antennæ paler and the joints shorter and the male and the abdomen is below the average size in this genus. Length, 2.25 mm.; antennæ, 2 mm.; wings, 2.25 mm. (H. F. Bassett.)

Gall: (Plate XVI, Figs. 5, 6). Among the buds of thrifty young shoots of white oak (*Quercus alba*) early in May. The gall is oblong oval, thin-shelled and of a blackish brown color. It does not prevent the development of the leaves below it, but immediately surrounding its base half a dozen or more long, brown thread-like bodies appear. The fly emerges from the apex of the cell, leaving it resembling a miniature egg-shell with the end removed. Length about 2.50 mm.; diameter about 1.5 mm.

Habitat: Connecticut (Waterbury); New York; New Jersey; Pennsylvania.

The flies emerge from the gall during May.

Dryophanta ignota (*Bassett*).

Cynips ignota Bassett, Can. Ent., Vol. XIII, 1881, p. 106.

Andricus ignotus Ashmead, Trans. Am. Ent. Soc., Vol. XII, 1885, p. 295.

Dryophanta ignota Ashmead, Trans. Am. Ent. Soc., Vol. XIV, 1887, p. 127; Dalla Torre, Cat. Hymen., Vol. II, 1893, p. 52; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 52.

Diplolepis ignota Dalla Torre and Kieffer, Das Tierreich, pt. XXIV, 1910, p. 360.

Female: Head black, finely rugose. Antennæ 13-jointed, first and second joints short, second slightly shorter, dusky yellowish brown, third joint long and slender, fourth shorter, remaining joints shorter and subequal, gradually becoming darker toward the tip. Thorax black, microscopically wrinkled or crackled. Parapsidal grooves present and rather distinct. Anterior parallel lines and lateral grooves not evident. Scutellum finely rugose, basal groove present, somewhat shining. Abdomen black. Legs pale yellowish brown, posterior femora infuscated. Wings hyaline, veins pale. Radial area open. Cubital vein slender and very faint. Areolet present. Length, 1.25–1.50 mm.

Gall: (Plate XIII, Fig. 10). On the mid-rib and principal veins on the under side of the leaves of swamp white oak (*Quercus platanoides*). Singly or in clusters of from two to ten. Monothalamous. Oval, rather thick-shelled and lie in a position nearly horizontal to the surface of the leaf. Brown, microscopically rugose with a number of short papillæ. Hollow inside. They are at first covered with short wooly hairs, but when mature become more or less denuded. Length about 3 mm. Width about 1.50 mm.

Habitat: Massachusetts; Connecticut; New York; New Jersey; Pennsylvania; Ohio; Illinois.

Dryophanta longicornis *Bassett.*

Dryophanta longicornis Bassett, Trans. Am. Ent. Soc., Vol. XXVI, 1900, p. 327; Dalla Torre and Kieffer, Gen. Ins. Hymen, Fam. Cynip., 1902, p. 53.

Diplolepis longicornis Dalla Torre and Kieffer, Das Tierreich, pt. XXIV, 1910, p. 359.

Male: Head black. Antennæ long, 15-jointed, first and second joints short, globose and of equal length, third one-third longer than the first two, fourth equal to the first two, fifth almost equal to the fourth, the following gradually shorter, and all of a dark brown color. Thorax black and shining in that portion within the deep parapsidal grooves. Median and alar lines wanting. Scutellum coarsely rugose and with short, scattered hairs. Foveæ obsolete, but a slight depression takes their place, this rough like the rest of the scutellum. Abdomen black and smooth. Legs rather pale red or reddish brown. Wings large and smoky brown; veins all distinct and reddish-brown. Radial area open. Areolet absent. Cubitus full length, but slender towards the first transverse. Body, 1.75 mm.; antennæ, 2.75 mm.; wings, 3 mm.

Female: Body, 2.50 mm.; antennæ, 2.75 mm.; wings, 3 mm. (H. F. Bassett.)

Habitat: Connecticut (Waterbury).

Two males and one female were bred by H. F. Bassett from galls found among the galls from which *Andricus exiguus* and *Neuroterus exiguus* were bred. According to Bassett the galls of *D. longicornis* are probably moderate enlargements of the upper portion of very young and tender shoots, and not at all prominent. The antennæ of the female are 14-jointed.

Dryophanta papula (*Bassett*).

Cynips papula Bassett, Can. Ent., Vol. XIII, 1881, p. 107.

Andricus papula Ashmead, Trans. Am. Ent. Soc., Vol. XII, 1885, p. 295.

Dryophanta papula Ashmead, Trans. Am. Ent. Soc., Vol. XIV, 1887, p. 129; Gillette, 27th Rep. Agricul. Mich., 1888, p. 470; Psyche, Vol. V, 1889, p. 187; Proc. Iowa Acad. Sci., Vol. I, pt. II, 1892, p. 113; Dalla Torre, Cat. Hymen., Vol. II, 1893, p. 53; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 53.

Diplolepis papula Dalla Torre and Kieffer, Das Tierreich, pt. XXIV, 1910, p. 361.

Female: Head dark reddish brown, a few white hairs on the posterior edge of the vertex. Ocelli large. Vertex finely punctate. Antennæ brownish red, darker towards the extremity; 13-jointed, the last three joints joined, and forming a rather heavy club, such as is seen in many Braconides. Thorax black, lusterless, sparsely covered with very fine short hairs. Parapsidal grooves faint and indistinct; converging slightly as they approach the scutellum. A very fine median line, discernible on the posterior part of the mesothorax, extends one-third the distance to the collar. Scutellum finely rugose; foveæ present but indistinct. Legs reddish brown. Abdomen shining black. Sheath of the ovipositor yellowish. Ovipositor yellowish brown, and remarkable for its length. In all my dry specimens it is exserted to a length at least five times that of the entire body, and is coiled two or three times. Wings hyaline. Costal and first and second cross-veins fine clear reddish brown, the others fine and nearly colorless. Cubitus extremely faint, and disappearing before reaching the first transverse. Areolet small and elongated, and in some

specimens wanting. Radial area open. Length, body 2 mm.; wing, 1.75 mm.; antennæ, 1 mm. (H. F. Bassett).

Gall: (Plate XV, Fig. 11). In clusters on the upper side of the leaves of red oak (*Quercus rubra*) and black oak (*Quercus velutina*) in June. On the under side of the leaf they appear as scars, projecting a little. Monothalamous. The clusters are composed of small papillose or cone-like galls, projecting unequally and usually so crowded as to form a confluent mass of pustule-like elevations. Sometimes from forty to one hundred clusters are found upon a single leaf.

Habitat: Massachusetts; Connecticut; New York; New Jersey; Pennsylvania.

Dryophanta parvula *Bassett.*

Dryophanta parvula Bassett, Trans. Am. Ent. Soc., Vol. XXVI, 1900, p. 326; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 53.

Diplolepis parvula Dalla Torre and Kieffer, Das Tierreich, pt. XXIV, 1910, p. 362.

Female: Entire body black. Head a little broader than the thorax. Antennæ 13-jointed; first joint large, short and dark, second large, globose and equalling the first in length, third rather long and slender, remaining joints equal in length, two to eleven yellowish brown, twelve and thirteen dark, dusky brown. Thorax — the two median lines which extend two thirds the distance from the collar to the scutellum, the parapsides and the lines at the base of each wing are all smooth and shining. The parapsides are not broad, and they converge closely at the scutellum. Scutellum finely wrinkled or rugose. Foveæ wanting. Abdomen polished and shining. Legs dark, translucent brown. Wings hyaline; veins faint and slender. Radial area broader than usual. Areolet wanting. Length of body, 1.25 mm.; antennæ, 1.25 mm.; wings, 1.75 mm. (H. F. Bassett.)

This species was described from a single specimen, found ovipositing in the buds of scrub oak (*Quercus nana*) May 26, 1871. Nothing further concerning it is known.

Dryophanta palustris (*Osten Sacken*).

Cynips (*Trigonaspis*?) *quercus palustris* Osten Sacken, Proc. Ent. Soc. Phila., Vol. I, 1861, p. 63.

Cynips q. palustris Osten Sacken, Ent. Zeit. Stettin, 1861, pp. 409, 412; Proc. Ent. Soc. Phila., Vol. IV, 1865, pp. 343, 346, 349; Bassett, Proc. Ent. Soc. Phila.; Vol. II, 1863, p. 329; Walsh, Proc. Ent. Soc. Phila., Vol. II, 1864, p. 488.

Cynips quercus palustris Osten Sacken, Proc. Ent. Soc. Phila., Vol. IV, 1865, p. 359; Trans. Am. Ent. Soc., Vol. III, 1870, p. 54; Packard, 5th Rep. U. S. Ent. Com., 1890, p. 113.

Andricus (*Callirhytis*) *palustris* Mayr, Gen. Gallenb. Cynip., 1881, p. 28; Ashmead, Trans. Am. Ent. Soc., Vol. XII, 1885, p. 294; Provancher, Addit. Fauna Canad. Hymen., 1886, p. 54; Beutenmüller, Bull. Am. Mus. Nat. Hist., Vol. IV, 1892, p. 256.

Dryophanta palustris Ashmead, Trans. Am. Ent. Soc., Vol. XIV, 1887, p. 129; Dalla Torre, Cat. Hymen., Vol. II, 1893, p. 53.

Andricus palustris Beutenmüller, Am. Mus. Journ., Vol. IV, 1904, p. 101, fig. 26; Ins. Galls Vicin. N. Y., 1904, p. 15, fig. 26; Cook, 29th Rep. Dept. Geol. Nat. Hist. Indiana, 1904 (1905) p. 829, fig. 22; Jarvis, 37th Rep. Ent. Soc. Ont., 1906.

Callirhytis quercus palustris Dalla Torre and Kieffer, Das Tierreich, pt. XXIV, 1910, p. 565.

Female: Head black, mouth and palpi yellowish brown, minutely rugoso-punctate. Antennæ 14-jointed, first to fourth yellowish brown, remaining joints dark brown, first joint stout, second globose and shorter, third long and slender, fourth shorter than third, the rest short and subequal. Thorax black, shining, apparently smooth, microscopically crackled under a high power lens. Parapsidal grooves distinct. Median groove more or less present. Scutellum finely rugose, with a deep basal groove. Abdomen black and shining. Legs very pale yellow, claws black. Wings hyaline, veins brown, cubitus continuous, faint. Areolet distinct. Basal vein usually clouded. Radial area closed. Length, 1.75–2 mm.

Male: Similar to the female. Antennæ 15-jointed, with the third joint thicker, and the basal joints darker. Length, 1.50–2 mm.

Gall: (Plate XV, Figs. 1, 2, 3, 4 and Plate XVII, Figs. 1, 2). On the leaves and buds and catkins of the pin oak (*Quercus palustris*), red oak (*Quercus rubra*), scarlet oak (*Quercus coccinea*), black oak (*Quercus velutina*), scrub oak (*Quercus nana*), black jack oak (*Quercus marylandica*), willow oak (*Quercus phellos*), and probably other oaks belonging to the red oak group, in May. Monothalamous. Globular, succulent, hollow inside, containing a whitish globular kernel which rolls freely around. The gall is green, sometimes more or less tinged with red. It is smooth or somewhat pubescent, when found on oaks which have under sides of the leaves pubescent (*Q. nana*, *Q. velutina*, and *Q. marylandica*). Diameter, 5–12 mm.

Habitat: Canada (Ottawa). New England States; Middle States; Ohio; Illinois; Indiana; Michigan; Washington, D. C., and probably southward into Florida.

In the latitude of New York the gall appears commonly very early in spring, on the buds of the oak, before any leaves have appeared, and when the leaves are out the galls are usually close to the leaf stalk, or they take in the entire leaf. The gall occurs singly or in clusters of two or more. The flies emerge about the middle of May. In June, after all the flies have escaped, the gall shrinks and gradually disappears entirely.

Dryophanta laurifoliæ (*Ashmead*).

Spathogaster q. laurifoliæ Ashmead, Trans. Am. Ent. Soc., Vol. IX, 1881, p. XVII.

Dryophanta laurifoliæ Ashmead, Trans. Am. Ent. Soc., Vol. XII, 1885, p. 296; *ibid.*, Vol. XIV, 1887, p. 129; Mayr, Verh. Zool.-Bot. Gesell. Wien, Vol. XXXVI, 1886, p. 371; Dalla Torre, Cat. Hymen., Vol. II, 1893, p. 52; Bridwell, Trans. Kan. Acad. Sci., Vol. XVI, 1899, p. 204; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 52.

Diplolepis quercuslaurifoliæ Dalla Torre and Kieffer, Das. Tierreich, pt. XXIV, 1910, p. 364.

Female: Black, head slightly but faintly punctured, mouth parts reddish, palpi yellowish. Antennæ 14-jointed, joints one and two yellowish, others dark reddish brown, pubescent, third joint nearly thrice as long as second; thorax smooth but appearing microscopically punctate with a high power, parapsidal grooves moderately distinct, longitudinal furrows distinct; scutellum deeply rugoso-punctate, opaque and slightly hairy; abdomen globose, smooth, black and highly polished; wings hyaline, veins black; legs yellowish-red, posterior coxæ excepting apex and feet black. Length, 2.50 mm. (W. H. Ashmead.)

Male: Antennæ 15-jointed; elevated and projecting posteriorly; wings very long reaching way beyond tip of abdomen; abdomen small, triangular, compressed, with a very long peduncle, slightly bent downwards before the middle; otherwise as in female. Length, 2 mm. (W. H. Ashmead.)

Gall: (Plate XV, Fig. 5). On leaf of laurel leafed oak (*Quercus laurifoliæ*) in February. Green, globular, hollow galls, growing through the leafy expansion of the newly formed leaf, projecting about equally from the upper and on the under surface of the leaf, the size of a cherry stone and when removed not unlike it in shape, containing a yellowish, slightly elongated kernel, which rolls freely about. Length, 5–6.25 mm. or 3.75 mm. or more through

Habitat: Florida (Jacksonville); Kansas.

I have examined the types of *D. laurifoliæ* and cannot find any essential differences between this species and *D. palustris*. But for the want of conclusive evidence I prefer to consider *D. laurifoliæ* tentatively distinct. The gall is also similar.

Dryophanta aquaticæ (*Ashmead*).

Cynip q. aquaticæ Ashmead, Trans. Am. Ent. Soc., Vol. IX, 1881, p. XVI.

Dryophanta aquaticæ Ashmead, Trans. Am. Ent. Soc., Vol. XII, 1885, p. 296; *ibid.*, Vol. XIX, 1887, p. 129; Dalla Torre, Cat. Hymen., Vol. II, 1893, p. 48; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 52.

Diplolepis quercus aquaticæ Dalla Torre and Kieffer, Das Tierreich, pt. XXIV, 1910, p. 365.

Female: Head black, finely punctate, a slight depression at base of front ocelli, a few microscopical short whitish hairs on face, mandibles black, palpi whitish; antennæ 15-jointed, yellowish red, infuscated from fourth joint, joints regularly subequal, last joint being longer than penultimate; thorax black, smooth and shining, parapsidal grooves distinct, converging towards scutellum and separated from it by a slight ridge; scutellum punctate; abdomen longer and wider than thorax, black, smooth and shining; legs reddish-yellow, tibiæ to feet paler, basal half of coxæ black; wings hyaline, radial area open, areolet distinct, veins black. Length, 2.50. (W. H. Ashmead.)

Male: Mouth parts brownish, scutellum coarsely rugoso-punctate, peduncle long; leg yellowish-brown, coxæ yellowish, feet black. Length, 2 mm. (W. H. Ashmead).

Gall: (Plate XV, Fig. 6). Growing through the leafy expansion of the newly formed leaf of water oak (*Quercus nigra* = *aquatica*) in March and April. Globular,

hollow, projecting about equally from the upper and the under side of the leaf, containing a yellowish, slightly elongated kernel, which rolls freely about. It is succulent and of a plum color. Diameter, 8–10 mm.

Habitat: Florida (Jacksonville).

The type is exceedingly close to *D. palustris* and may not be distinct. But from the lack of sufficient material I prefer not to unite *D. aquatica* with *D. palustris.*

Dryophanta liberæcellulæ *Gillette.*

Dryophanta liberæcellulæ Gillette, Bull. 7, Iowa Agricul. Exp. Sta., 1889, p. 283, fig. 27; Ent. Am., Vol. VI, 1890, p. 24, fig. 1; Proc. Iowa Acad. Sci., Vol. I, pt. II, 1892, p. 113; Dalla Torre, Cat. Hymen., Vol. II, 1893, p. 52; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 53.

Diplolepis liberæ-cellulæ Dalla Torre and Kieffer, Das Tierreich, pt. XXIV, 1910, p. 360.

Female: Head shining black, with two deep pits at the base of the clypeus, one on either side; face finely rugose; mandibles black, sometimes yellowish at base; palpi light yellow to yellowish brown. Antennæ 14-jointed, first four or five joints light yellow, terminal joints black, first and second joints short and stout, third joint longest, terminal joint cone-shaped and a little longer than the penultimate. Thorax shining black and finely rugose, parapsidal grooves distinct; a medium impressed line begins at the scutellum between the parapsidal grooves and extends a short distance upon the thorax. Scutellum polished, bifoveate and more coarsely rugose than the thorax. Abdomen entirely black and polished; ovipositor sheaths slightly exserted and light yellow in color. Wings slightly smoky, and 3 mm. in length, areolet very small or entirely wanting. Feet light yellow, except the last tarsus, which is black. Length, 2.3 mm. (C. P. Gillette.)

Male: The yellow coloration of the antennæ shows for nearly the entire length on the upper surface, the number of the joints is fifteen, and they are more densely set with hairs than in the female. Otherwise as in the female. Length, 2 mm. (C. P. Gillette).

Gall: Globular excrescences on the leaves of the red and scarlet oaks, sometimes taking into themselves the entire leaf and at others surrounded by the blade of the leaf of *Amphibolips nubilipennis* or *Andricus singularis,* either of which it very much resembles, but from which it differs by having a somewhat roughened and fuzzy exterior and a much thicker outer wall, and by having the larval cell perfectly free to roll about within. The galls vary from 6.5 to 9.5 mm. in diameter. (C. P. Gillette).

Habitat: Iowa (Ames); Michigan.

I am fairly positive that this species will prove to be the same as *D. palustris.* The descriptions of flies and gall tally with *D. palustris.* A shrivelled type gall and fly are in the United States National Museum. I have examined these types and, according to my notes, do not find them different from *D. palustris.*

Dryophanta quercifoliæ *Ashmead.*

Andricus quercifoliæ ASHMEAD, Trans. Am. Ent. Soc., Vol. XII, 1885, p. 299.

Andricus (Callirhytis) quercifoliæ ASHMEAD, Trans. Am. Ent. Soc., Vol. XII, 1885, p. 295.

Dryophanta quercifoliæ ASHMEAD, Trans. Am. Ent. Soc., Vol. XIV, 1887, p. 129; DALLA TORRE, Cat. Hymen., Vol. II, 1893, p. 54; DALLA TORRE and KIEFFER, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 53.

Diplolepis querci-foliæ DALLA TORRE and KIEFFER, Das Tierreich, pt. XXIV, 1910, p. 365.

Male: Black, shining, sparsely pubescent and microscopically scratched; antennæ 14-jointed, honey yellow at base, brownish towards tip; thorax smooth, parapsidal grooves distinct; scutellum rugose, pubescent; abdomen polished black, slightly compressed; legs honey yellow; wings hyaline, veins brownish. Length, 1.75 mm. (W. H. Ashmead.)

Gall: On the leaves of turkey oak (*Quercus catesbæi*) in April and May. Succulent, round, green, with a loose, whitish kernel. Constructed in the same manner as *Dryophanta aquaticæ*, but much smaller.

Habitat: Florida (Jacksonville).

Closely allied to *D. palustris*. The thorax, however, appears to be smoother, and the gall is longer and somewhat cup-shaped.

Dryophanta confusa (*Ashmead*).

Cynips q. confusa ASHMEAD, Trans. Am. Ent. Soc., Vol. IX, 1881, p. XVIII.

Neuroterus confusus ASHMEAD, Trans. Am. Ent. Soc., Vol. XII, 1885, p. 296.

Dryophanta confusa ASHMEAD, Trans. Am. Ent. Soc., Vol. XIV, 1887, p. 129; DALLA TORRE, Cat. Hymen., Vol. II, 1893, p. 49; DALLA TORRE and KIEFFER, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 52.

Diplolepis quercus-confusa DALLA TORRE and KIEFFER, Das Tierreich, pt. XXIV, 1910, p. 362.

Female: Head black, finely and evenly punctate. Antennæ reddish-brown, 14-jointed, third joint longest, joints to eighth subequal, others short and equal, terminal twice as long as penultimate. Thorax rugoso-punctate, parapsidal grooves distinct, converging posteriorly. Scutellum deeply rugoso-punctate, slightly elevated posteriorly and depressed and with a large deep foveæ at base, not pubescent. Pleuræ deeply aciculate. Wings hyaline, veins reddish-brown. Areolet nearly closed. Radial area open. Abdomen black and highly polished, last ventral valve projecting. Legs reddish yellow, coxæ black. Length 1.75 mm. (W. H. Ashmead.)

Gall: Attached to the principal vein on the under side of the leaf of laurel oak (*Quercus laurifolia*) in April. Small, globular, succulent, yellowish-green. Hollow inside with a pupa-like kernel. Diameter transversely, 1.50 mm.; vertically, 2.50 mm.

Habitat: Florida (Jacksonville).

The gall and flies are not known to me and the types should be in the United States National Museum. According to Ashmead the fly escapes by perforating a hole through the upper surface of the leaf.

Dryophanta notha (*Osten Sacken*).

Cynips q. notha Osten Sacken, Trans. Am. Ent. Soc., Vol. III, 1870, p. 55.

Andricus (*Callirhytis*) *notha* Ashmead, Trans. Am. Ent. Soc., Vol. XII, 1885, p. 295.

Dryophanta notha Ashmead, Trans. Am. Ent. Soc., Vol. XIV, 1887, p. 129; Dalla Torre, Cat. Hymen., Vol. II, 1893, p. 53.

Callirhytis notha Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 66.

Callirhytis quercus-notha Dalla Torre and Kieffer, Das Tierreich, pt. XXIV, 1910, p. 565.

Andricus (*Callirhytis*) *pustulatoides* Bassett, Trans. Am. Ent. Soc., Vol. XVII, 1890, p. 74.

Andricus pustulatoides Dalla Torre, Cat. Hymen., Vol. II, 1893, p. 94.

Neuroterus notha Ashmead, Proc. Ent. Soc. Wash., Vol. IV, 1899, p. 332.

Callirhytis pustulatoides Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, 66; Das Tierreich, pt. XXIV, 1910, p. 570.

Female: Head punctate, black. Antennæ 14-jointed, first to fourth joints pale yellowish, remaining ones gradually changing to dark brown. Thorax black, smooth, polished, slightly rugose anteriorly and along the parapsidal grooves, which are distinct and converge closely at the scutellum. Lateral grooves and parallel anterior lines wanting. Median line at the scutellum very short. Scutellum finely rugose, foveæ at base longer than broad and distinct. Abdomen black, smooth and polished. Legs dark yellowish brown, coxæ black. Claws simple. Wings hyaline, slightly dusky. Veins distinct. Areolet wanting. Cubitus not extending to the first cross-vein. Radial area open. Length, 2.50 mm.

Gall: (Plate XVI, Fig. 4). Singly on the points of the acute lobes of the leaves of scarlet oak (*Quercus coccinea*), red oak (*Quercus rubra*), and pin oak (*Quercus palustris*), in May. Monothalamous. Blister or bubble-like, oblong, thin-shelled and succulent. It is green and the surface shows some longitudinal semitransparent veins. Hollow inside, containing a free seed-like kernel in which the larva lives. This kernel is oblong oval, rounded at one end and somewhat pointed at the other.

Habitat: Massachusetts; Connecticut; New York; New Jersey; Pennsylvania.

The species described by Bassett, as *Andricus* (*Callirhytis*) *pustulatoides* is the same as *Dryophanta notha*. The flies emerge late in May and early in June.

Dryophanta pedunculata *Bassett.*

Dryophanta pedunculata Bassett, Trans. Am. Ent. Soc., Vol. XVII, 1890, p. 72; Dalla Torre, Cat. Hymen., Vol. II, 1893, p. 53; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 53.

Diplolepis pedunculata Dalla Torre and Kieffer, Das Tierreich, pt. XXIV, 1910, p. 364.

Female: Head dark brown black, minutely rugulose. Antennæ 14-jointed, first to fourth joints pale yellowish, all the others dark brown. Thorax microscopically punctate, black or very deep brown black, shining. Parapsidal grooves fine

but distinct. Anterior parallel lines and lateral grooves only visible in certain lights. Scutellum finely rugose, more so than the thorax; basal groove present, but not very distinct. Abdomen shining, black. Legs pale yellowish, middle of femora slightly darker. Wings hyaline, veins dark brown. Cubitus faint and continuous. Areolet present. Radial area closed. Length 2 mm.

Male: Color as in the female. Antennæ 15-jointed, third joint somewhat bent. Legs slightly darker. Abdomen very small, pedunculate. Length, 1.50 mm.

Gall: (Plate XIII, Figs. 8, 9). On the edges of the leaves of red oak (*Quercus rubra*) and scarlet oak (*Quercus coccinea*) in Spring. Ovate with a rather long, curved point at the apex. The gall is on a thread-like peduncle measuring from 5 to 12 mm. in length. When fresh it is glaucous and when dry dark olive brown. Thin-shelled, hollow inside with a free kernel in which the larva lives. Length of gall, 4–5 mm.; width, 2.5–3 mm.

Habitat: Connecticut; New York; New Jersey.

The galls from *Quercus obtusiloba* and *Q. prinus* recorded by Packard (5th Rep. U. S. Ent. Com., 1890, p. 114) belong to another species, probably *Andricus capsula* Bass.

Dryophanta cinereæ *Ashmead.*

Dryophanta cinereæ Ashmead, Trans. Am. Ent. Soc., Vol. XIV, 1887, pp. 129, 144; Dalla Torre, Cat. Hymen., Vol. II, 1893, p. 49; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 52.

Diplolepis cinereæ Dalla Torre and Kieffer, Das Tierreich, pt. XXIV, 1910, p. 365.

Female: Head black, distinctly and finely reticulately punctate. Antennæ 14-jointed, brown. Thorax black, minutely punctate. Parapsidal grooves sharply defined posteriorly, less so anteriorly. Anterior parallel lines present, but not distinct. Lateral grooves wanting. Scutellum very finely rugose with a groove at base. Abdomen black, shining, smooth. Legs pale yellow, hind femora infuscated and a faint brownish blotch on the basal third of the posterior tibiæ. Wings hyaline, veins pale. Radial area closed. Length, 1.75 mm.

Male: Very similar to the female in color, but the head and thorax are less distinctly sculptured and the antennæ are 15-jointed.

Gall: (Plate XIII, Figs. 11, 12). On the under side of the leaves of upland willow oak (*Quercus brevifolia* = *Q. cinerea*), in April and May. Monothalamous. Greenish gray, somewhat longitudinally ribbed and rugose. Hemispherical or bag-shaped, thin-shelled, containing a loose kernel which rolls around freely. On the upper side the gall is indicated by a slight discoloration of the leaf. Diameter at base, 4 mm.; Height, 3.25 mm.

Habitat: Florida (Jacksonville).

The gall of *D. cinereæ* is practically the same as that of *Callirhytis saccularia* (Plate XV, Figs. 7, 8) and it is possible that the latter species will prove to be a synonym of *D. cinerea.*

Dryophanta clarkei *Bassett.*

Dryophanta clarkei Bassett, Trans. Am. Ent. Soc., Vol. XVII, 1890, p. 69; Dalla Torre, Cat. Hymen., Vol. II, 1893, p. 49; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 52; Das Tierreich, pt. XXIV, 1910, p. 361.

Dryophanta vesiculoides Ashmead, Proc. U. S. Nat. Mus., Vol. XIX, 1896, p. 114; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 53.

Diplolepis vesiculoides Dalla Torre and Kieffer, Das Tierreich, pt. XXIV, 1910, p. 366.

Female: Head black minutely punctate. Antennæ 14-jointed, basal joints pale, terminal joints dark almost black. Thorax jet black, smooth and shining, with distinct heavy parapsidal grooves, as are also the lines over the base of the wings. Pleuræ glossy, smooth. Scutellum minutely rugose, shining foveæ at base small. Abdomen smooth and shining, black. Legs dark brown, yellowish brown at the joints, as are also the tarsi; claws dark. Wings hyaline, veins moderately heavy. Cubitus decreasing as it approaches the first cross-vein. Areolet present. Length, 1–1.50 mm.

Male: Similar to the female. Antennæ 15-jointed, first joint black, second globular, third rather short, curved and incised. Legs paler than those of the female. Abdomen very small and petiolate. Length, 1–1.5 mm.

Gall: (Plate XVI, Figs. 7, 8, 9, 10). Formed in the buds of the white oak (*Quercus alba*) and post oak (*Quercus minor*) in May. Polythalamous. Brown, small, round, thin-walled. Inside the larval cells are separated by very thin partitions. In general appearance the gall resembles that of *Neuroterus vesiculus*. Diameter about 3 mm.

Habitat: Massachusetts; New York; New Jersey (Lakehurst).

Bassett described this species from specimens received from Miss Cora H. Clarke, collected near Boston. I have received specimens from the same locality, also collected by Miss Clarke. In my specimens, all females, the antennæ are 14-jointed and not 13 as given by Bassett.

Dryophanta vesiculoides is the same as *D. clarkei*, and was bred from galls on post oak (*Quercus minor*).

Dryophanta discus *Bassett.*

Dryophanta discus Bassett, Trans. Am. Ent. Soc., Vol. XXVI, 1900, p. 326; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 52.

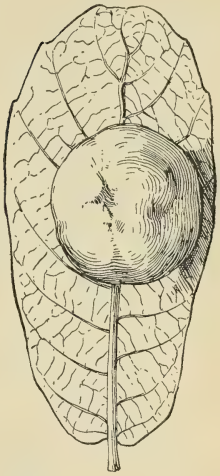
Diplolepis discus Dalla Torre and Kieffer, Das Tierreich, pt. XXIV, 1910, 362.

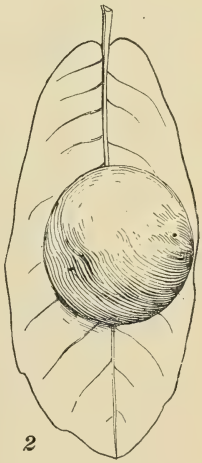
Female: Head black. Antennæ 13-jointed, first and second joints rather large, subequal, third long, fourth two thirds as long as the third, remaining joints gradually shorter, all yellowish red. Thorax smooth, shining, with a few scattered hairs and deep parapsidal grooves. Scutellum slightly rugose. Foveæ not distinct. Abdomen dark, shining brown. Legs dark brown. Wings rather large; veins very pale and almost colorless. Areolet wanting. Cubitus nearly obsolete. Radial area open. Length, body 1.50 mm.; antennæ, 1.25 mm.; wings, 1.75 mm.

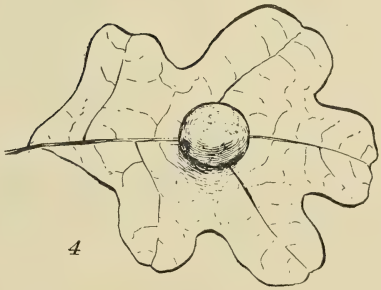
Gall: (Plate XVI, Fig. 13). In clusters on the under side of the leaves of *Quercus undulata?* or a closely allied species of white oak. Monothalamous. Small, flattened, saucer-like with a very minute point in the center. Circular with the edge slightly raised; very much resembles the eastern oak-spangles (*Cecidomia poculum* O. S.). Purplish red. Diameter, 1.50–2 mm.; height, .75 mm.

Habitat: California (Napa City).

The types are in the collection of the American Entomological Society. Nothing further concerning this species is known. It will probably prove to be identical with *Andricus parmula* Bassett.

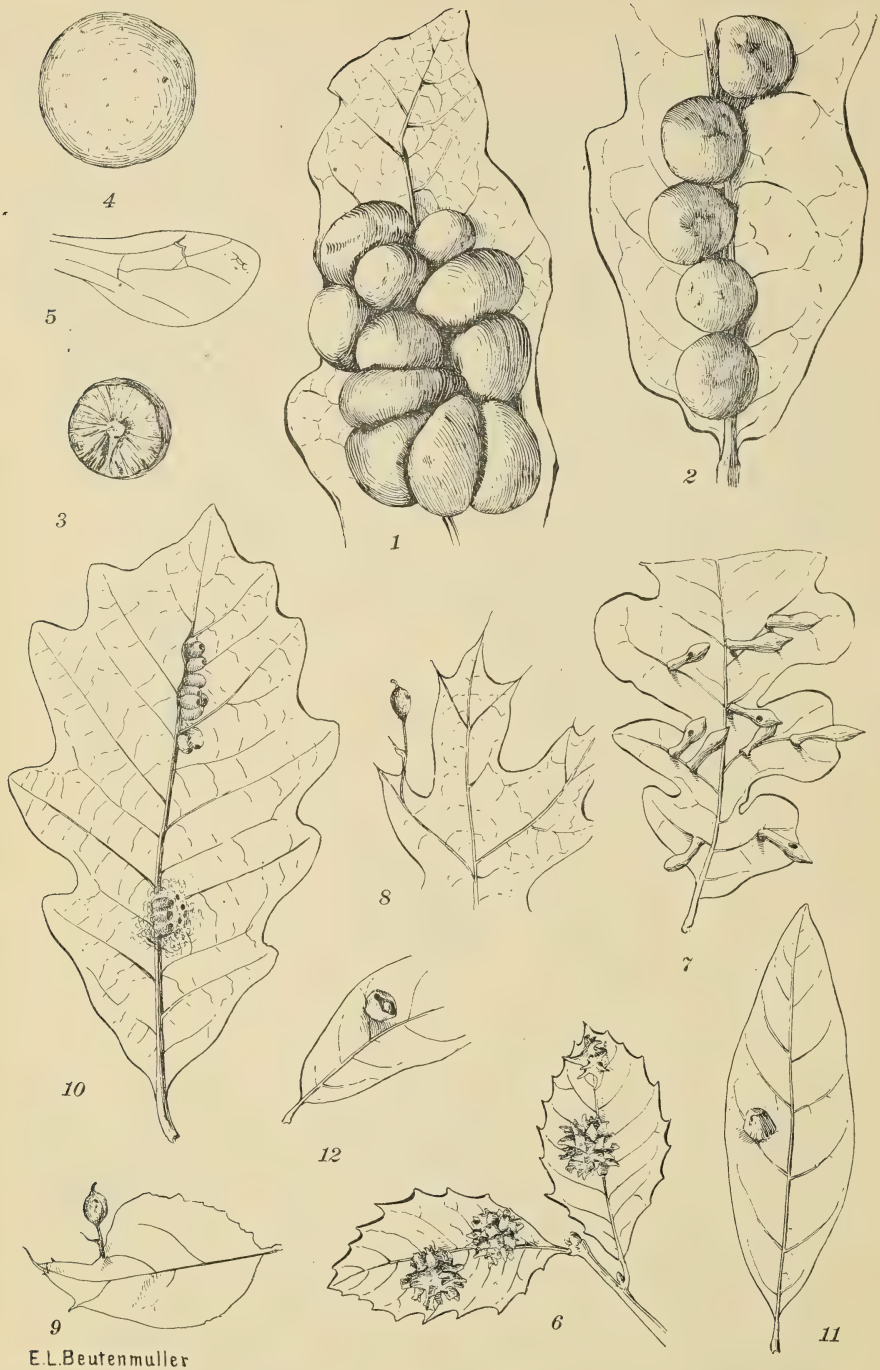




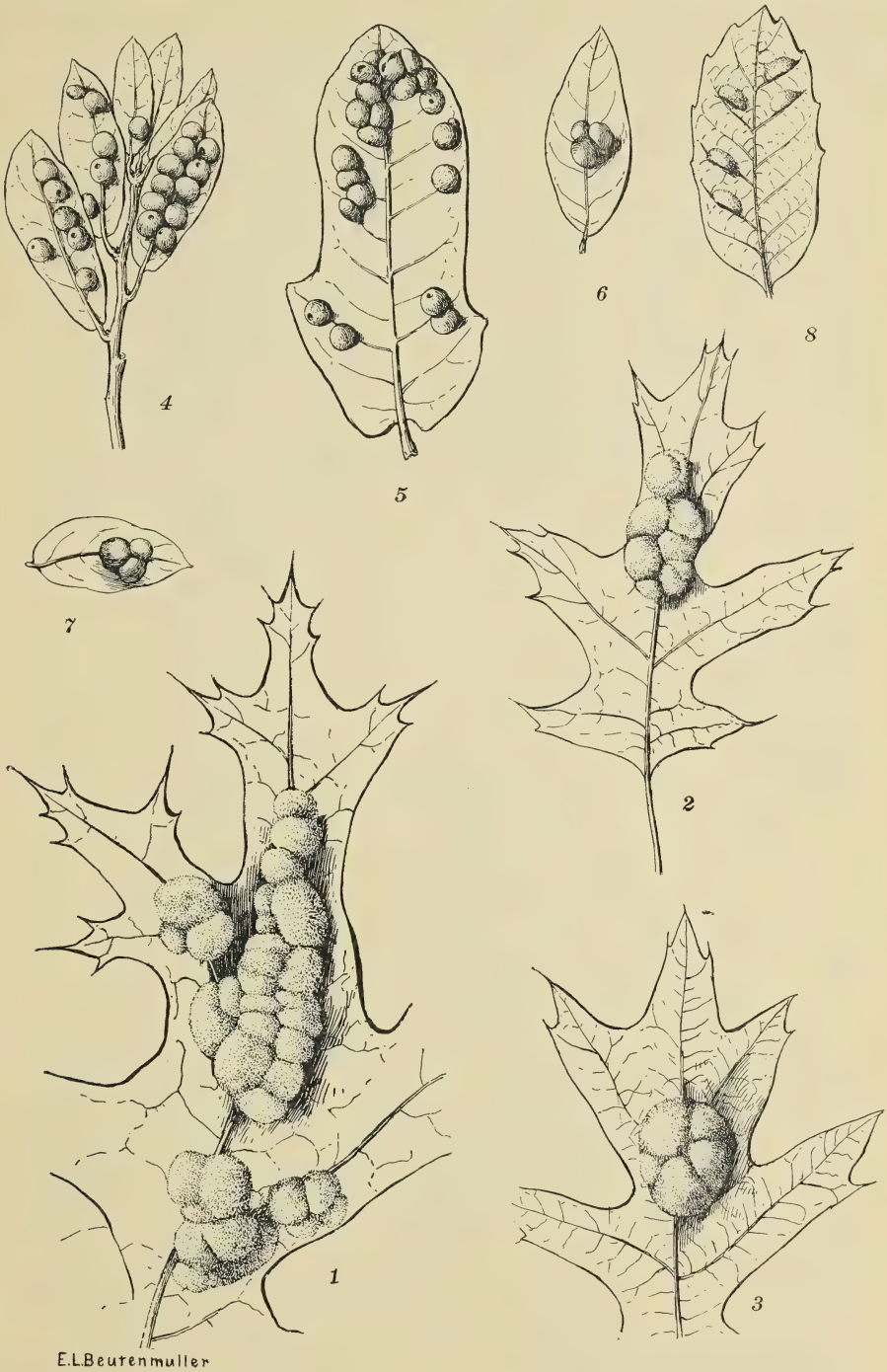


E.L.Beutenmuller

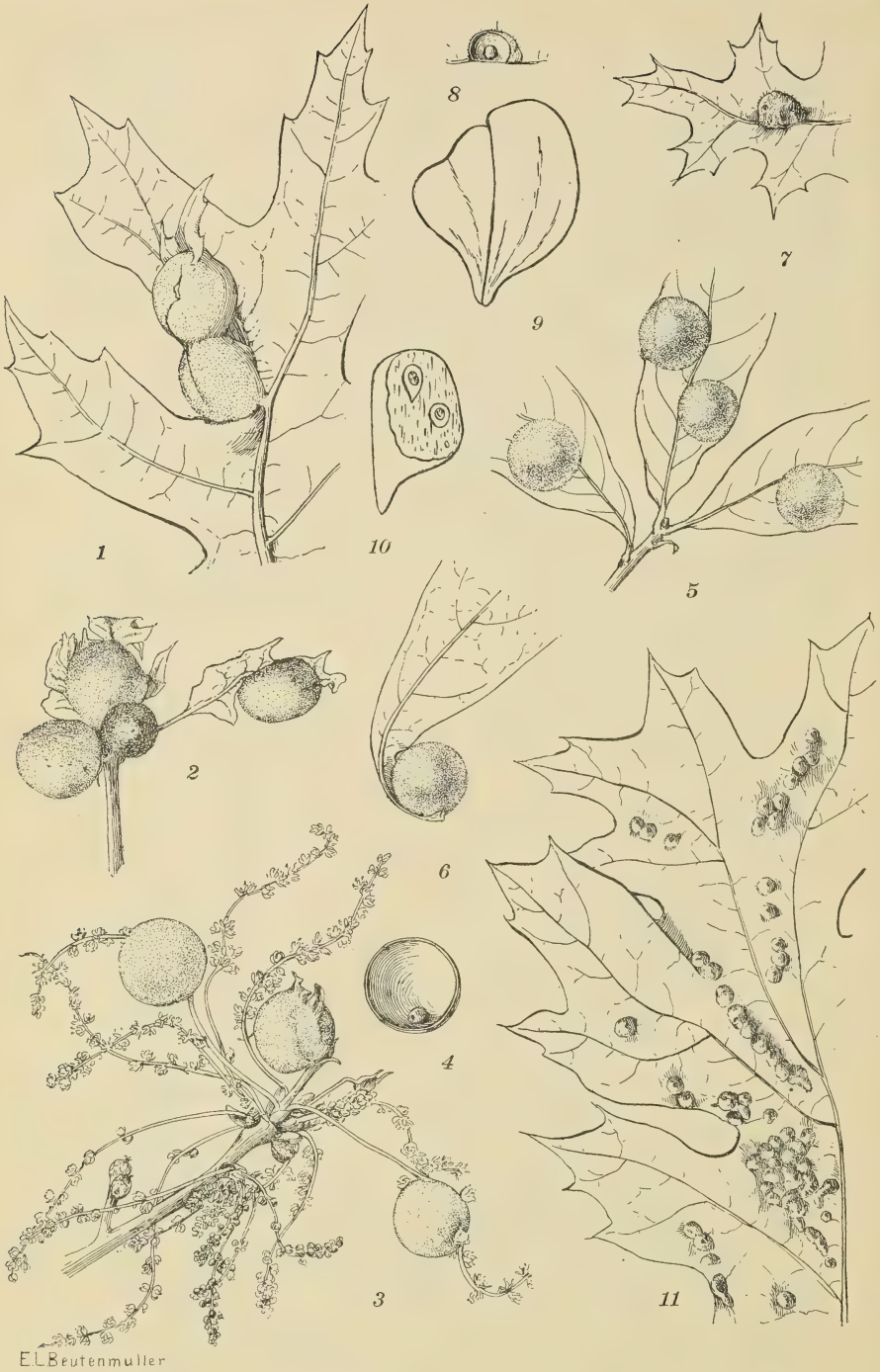
1–3. *Dryophanta bella* (Bassett).
4. " *carolina* Ashmead.
5. *Dryophanta multipunctata* Beutenmüller.
6, 7. *Dryophanta dugesi* Mayr.



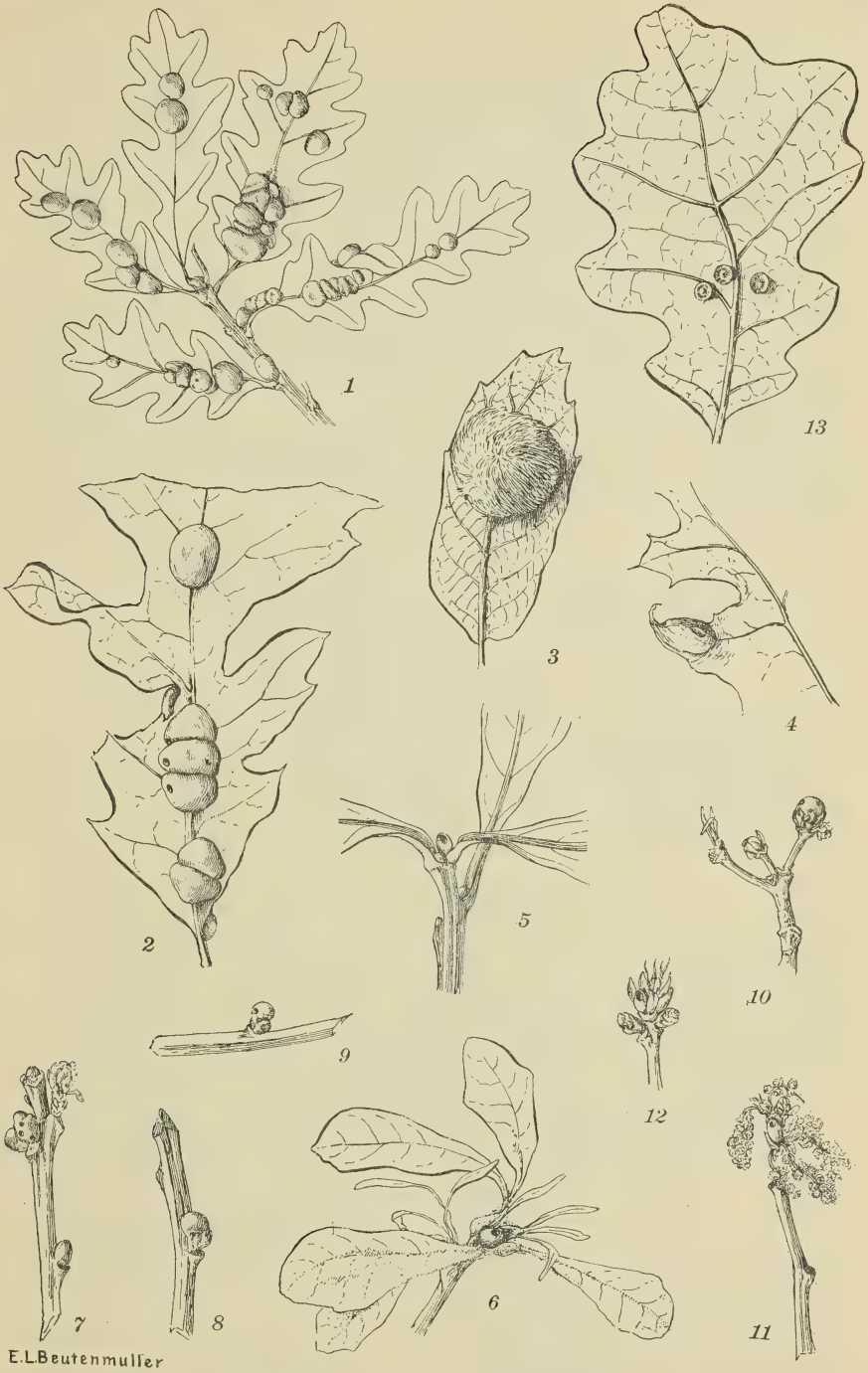
1–3. *Dryophanta polita* (Bassett).
4, 5. " *rubræ* (Karsch).
6. " *echinus* (Osten Sacken).
7. *Dryophanta clavula* Beutenmüller.
8, 9. " *pedunculata* Bassett.
10. " *ignota* (Bassett).
11–12. *Dryophanta cinereæ* Ashmead.



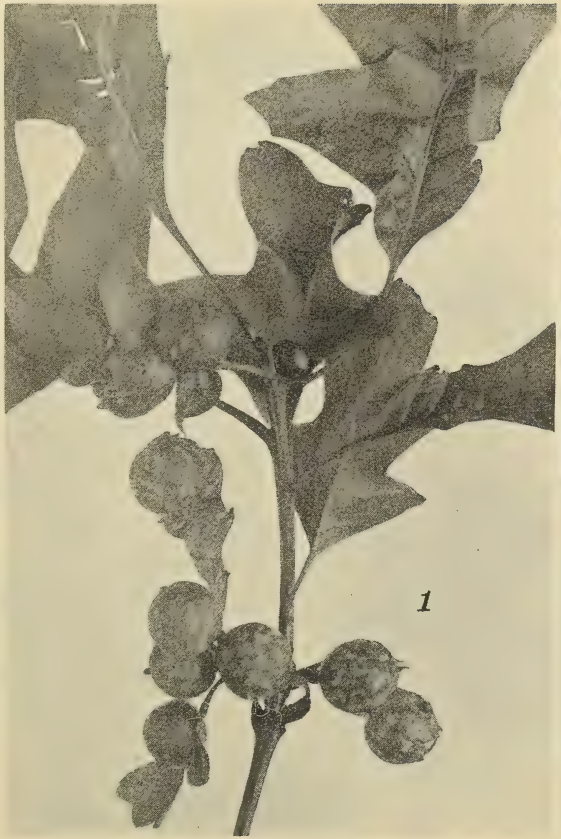
1–3. *Dryophanta lanata* Gillette.
4–7. " *emoryi* Ashmead.
8. " *pulchripennis* Ashmead.



1–4. *Dryophanta palustris* (Osten Sacken).
5. " *laurifoliæ* (Ashmead).
6. " *aquaticæ* (Ashmead).
7, 8. *Callirhytis sacularia* (Bassett).
9, 10. *Dryophanta radicola* Ashmead.
11. " *papula* Bassett.



1. *Dryophanta eburnea* Bassett.
2. " *glabra* Gillett.
3. " *nubila* Bassett.
4. " *notha* (Osten Sacken).
5, 6. *Dryophanta pallipes* Bassett.
7–9. " *vesiculoides* Ashmead.
10. " *clurkei* Bassett.
11, 12. " *gemula* (Bassett).
13. *Dryophanta discus* Bassett.



1. *Dryophanta palustris* (Osten Sacken), on Pin Oak (*Quercus palustris*).
2. " " (Osten Sacken), on Red Oak (*Quercus rubra*).

INDEX TO VOLUME XXX.

New names of genera, species, and subspecies are printed in **heavy-faced** type, also the main reference in a series of references.

Agouti paca, 249.
sierræ, 249.
Allen, J. A., mammals from Venezuela collected by Mr. M. A. Carriker, Jr., 1909–1911, 239–273; mammals collected in the Dutch East Indies by Mr. Roy C. Andrews on the cruise of the 'Albatross' in 1909, 335–342.
Alouatta macconnelli, 271.
Andrena **grandipes**, 73.
Andrews, Roy C., a new porpoise from Japan, 31–51; description of an apparently new porpoise of the genus *Tursiops*, with remarks upon a skull of *Tursiops gilli* Dall, 233–237.
Andricus quercifoliæ, 365.
speciosus, 351.
ignotus, 359.
nubila, 343.
papula, 360.
palustris, 362.
pustulatoides, 366.
(Callirhytis) notha, 366.
(Callirhytis) palustris, 361.
(Callirhytis) pustulatoides, 366.
(Callirhytis) quercifoliæ, 365.
Anochetus mayri **læviusculus**, 22.
Aphodius **florissantensis**, 59.
lamincola, 59.
Apion **cockerelli**, 65.
Aracoda **attentuata**, 5.
spatula, 6.
Artibeus cinereus, 269.
planirostris, 269.
Asilus **amelanchieris**, 79.
crabroniformis, 79.
Ateles variegatus, 272.
Atta (Trachymyrmex) jamaicensis, 29.

Balaninus **minusculoides**, 67.
minusculus, 68.
Balaninus restrictus, 67.
Beaver Creek, the Eocene-Oligocene of, 88–103.
Big Horn Basin, the Eocene-Oligocene of, 105–111.
Blennius fabbri, 277.
Brachyacantha, 280.
agathina, 327.
albifrons, 287, 289, 293, 308, **320**, 331.
aperta, 284, 288, 293, 322, **323**, 333.
arizonica, 280, 282, 283, 289, 292, **314**, 331.
australe, 292, 308, **313**, 333.
aymardi, 286, 291, **307**, 333.
basalis, 317, **318**, 331.
bilineata, 289, **295**.
bipartita, 306.
bistripustulata, 282, 283, 285, 286, 287, 290, **296**, 333.
bistripustulata decora, 290, 297, **298**, 333.
bistripustulata guttata, 290, **297**, 333.
bistripustulata **minor**, 290, 297, **298**.
bistripustulata **obscura**, 290, **299**, 333.
bistripustulata **quichiana**, 280, **298**, 333.
blaisdelli, 280, 290, **304**, 331.
bollii, 292, **314**, 331.
bruchi, 293, **326**, 333.
buckleyi, 289, **294**, 333.
cachensis, 293, **322**, 333.
congruens, 285.
conjuncta, 291, **306**, 333.
cryptocephalina, 291, **307**, 333.
decora, 282.
dentipes, 282, 283, 285 287, 290, **300**, 331.
dentipes **americana**, 290, 300, **302**, 333.
dentipes separata, 290, 300, **301**, 331.

Brachyacantha dentipes socialis, 290, 300, **302**, 331.
designata, 327.
diversa, 318.
dorsalis, 327.
duodecimguttata, 289, **294**, 333.
erythrocephala, 327.
erythrura, 290, **302**, 331.
felina, 292, **312**.
felina 10-pustulata, 292, 309, 313.
fenestrata, 288, 293, **322**, 333.
fenyesi, 292, **316**, 333.
fulvopustulata, 312.
illustris, 293, 308, **320**, 331.
indubitabilis, 292, 308, **315**, 331.
lepida, 288, 293, **324**, 333.
lepida **confluens**, 293, **325**, 333.
lepida reducta, 293, **325**.
mexicana, 292, 308, **316**, 333.
octostigma, 292, **311**, 331.
pacifica, 293, 308, **321**, 331.
propria, 292, 308, **313**.
pygidialis, 283, 287, 288, 293, **323**, 333.
quadrillum, 290, **303**, 331.
querciti, 280, 288, 293, **324**, 331.
sellata, 293, **325**, 327.
sicardi, 289, 295, 333.
stellata, 285.
sonorana, 286.
subfasciata, 290, **302**, 331.
tau, 289, 290, **305**, 331.
testudo, 292, **312**, 331.
trimaculata, 289, **295**, 333.
ursina, 281, 283, 285, 287, 291, 308, **309**, 331.
ursina var. congruens, 291, **310**, 331.
ursina var. sonorana, 292, **311**.
ursina var. stellata, 291, 309, **310**, 331.
uteella, 285, 292, **310**, 331.
westwoodii, 291, **305**, 333.
4-punctata, 281, 284, 292, 308, **316**, 331.
4-punctata confusa, 292, 306, **319**, 331.
4-punctata flavifrons, 292, 317, **319**, 331.
5-maculata, 327.
Brachyacantha **12-guttata**, 289, **294**, 333.
Brachymyrmex heeri, 29.
heeri var. obscurior, 29.
Bradypus tridactylus flaccidus, 247.
Bubalus mindorensis, 335.
Bustards, African, habits of in reference to concealment, 144.

Callimoxys **primordialis**, 61.
Callirhytis notha, 366.
Caluromys, 246.
Camponotus capperi, 29.
capperi corticalis var. subdepilis, 29.
hamani, 29.
hamani willardi, 29.
maculatus picipes, 29.
Canis cancrivorus, 258.
cancrivorus savannarum, 258.
thous, 258.
thous melampus, 258.
thous savannarum, 258.
thous thous, 258.
(Carcinocyon) thous, 257.
(Thous) cancrivorus savannarum, 258.
Cavia porcellus guianæ, 250, 251.
porcellus **venezuelæ**, 250.
Cardiocondyla emeryi, 23.
Cebus apiculatus, 273.
Centrobranchus andreæ, 16.
chœrocephalus, 16.
gracilicaudus, 16.
Cercopithecus, 341.
Ceruchus **fuchsii**, 58.
Ceutorhynchus clausus, 67.
Chasmodes bosquianus, 277.
Chilonycteris macleayi, 264.
personata, 263.
psilotis, 264.
rubignosa, 262.
rubignosa **fusca**, 262.
rubignosa mexicana, 263.
rubignosa rubignosa, 261.
Chrotopterus carrikeri, 267.
Chrysobothris **gahani**, 72.
Cicada grandiosa, 76.
Cleonus **rowheri**, 66.
Coccinella bistripustulata, 279.

Coccinella bisquinquepustulata, 279.
dentipes, 279.
erythrocephala, 279, 299.
felina, 279.
ursina, 279.
Cockerell, T. D. A., fossil insects from Florissant, Colorado, 71–82.
Colaspis **ætatis**, 61.
Concealing and protective coloration, 119–231; conclusions concerning, 212–219.
Conepatus marpurito, 257.
Cougar, its coloration not at all times concealing, 181–183; its habits and sharp senses prime factors in its concealment, 182.
Countershading plays an inconspicuous part in the concealment of mammals, 172–175.
Cratoparis **adumbratis**, 69.
Cremastogaster brevispinosa, 28.
brevispinosa var. minutior, 28.
victima var. steinheili, 28.
Cynips bella, 343.
echinus, 351.
gemula, 358.
ignota, 359.
papula, 360.
polita, 349.
quercus aquaticæ, 363.
quercus confusa, 365.
quercus echinus, 351.
quercus notha, 366.
quercus nubila, 343.
quercus palustris, 361.
(Trigonaspis?) quercus palustris, 361.
Cynopithecus niger, 337.
Cyphomyrmex foxi, 29.
rimosus minutus, 29.
Cyphus **subterraneus**, 64.

Dascyllus **lithographus**, 57.
Dasyprocta lucifer, 249.
rubrata, 249.
Dasyscopelus spinosus, 15.
Desmodus rotundus, 270.
Diabrotica **exesa**, 62.
Didelphis marsupialis marsupialis, 247.
Didelphis opossum, 247.
philander, 246.
Diplolepis bella, 343.
carolina, 346.
cinereæ, 367.
corrugis, 353.
discus, 368.
douglasi, 352.
dugesi, 343.
eburnea, 348.
emoryi, 356.
gemmula, 358.
glabra, 348.
ignota, 359.
lanata, 350.
liberæ-cellulæ, 363.
longicornis, 360.
pallipes, 358.
papula, 360.
parvula, 361.
pedunculata, 366.
polita, 349.
porteræ, 357.
querci-foliæ, 365.
quercus-aquaticæ, 363.
quercus centricola, 352.
quercus confusa, 365.
quercus laurifoliæ, 363.
quercus nubila, 344.
quercus rubræ, 351.
rydbergiana, 355.
simillima, 348.
speciosa, 351.
texana, 353.
vesiculoides, 368.
Docirhynchus culex, 6.
Dorymyrmex pyramicus var. niger, 29.
Dryophanta aquaticæ, 363.
bella, 343.
carolina, 346.
centricola, 352.
cinereæ, 367.
clarkei, 368.
clavula, 347.
confusa, 365.
corrugis, 353.
discus, 368.
douglasi, 352.
dugesi, 343.

Dryophanta eburnea, 348.
echinus, 351.
emoryi, 356.
gemula, 358.
glabra, 348.
ignota, 359.
lanata, 350.
laurifoliæ, 363.
liberæcellulæ, 364.
longicornis, 350.
multipunctata, 346.
notha, 366.
nubila, 343.
pallipes, 358.
palustris, 361.
papula, 360.
parvula, 361.
pedunculata, 366.
polita, 349.
porteræ, 357.
pulchella, 355.
pulchripennis, 357.
pumiliventris, 354.
quercifoliæ, 365.
radicicola, 354.
rubræ, 351.
rydbergiana, 355.
similis, 348.
simillima, 348.
speciosa, 351.
texana, 353.
vesiculoides, 368.
Dryops **eruptus**, 56.

Ectatomma (Gnamptogenys) interruptum, 21.
(Holcoponera) strigatum, 21.
Eland and other African antelopes do not seek concealment, 193–196.
Elaphidion **fracticorne**, 60, 61.
Elliot, D. G., the generic name *Cercopithecus*, 341,
Eocene and Post-Eocene Basins of accumulation, 85.
Eptesicus hilarii, 271.
Eriocampa **synthetica**, 74.
Eucallimyia, 82.
fortis, 82.

Felis pardalis (subsp.?), 259.
sanctæmartæ, 259.

Geralophus antiquarius, 65.
fossicius, 65.
lassatus, 65.
occultus, 65.
repositus,
scudderi, 65.
Gilbert, Charles H., notes on lantern fishes from southern seas, collected by J. T. Nichols in 1906, 13–19.
Giraffe, its coloration not concealing, 191.
Glossophaga longirostris, 268.
soricina, 268.
Granger, Walter, see Sinclair, W. J.

Harpalus **maceratus**, 54.
Hemiderma perspicillatum, 268.
Hermenia verruculosa, 9–11.
Heteromys anomalus, 252.
jesupi, 252.
Heterosciurus thaiwanensis centralis, 339.
thaiwanensis roberti, 339.
thaiwanensis thaiwanensis, 339.
Hydrobius **prisconatator**, 55.
Hylesinus extractus, 69.

Iridomyrmex iniquus, 29.

Lampanyctus **nicholsi**, 17.
Lasiopyga, 342.
Leia crassipalpes, 77.
crassiuscula, 77.
curvipetiolata, 77.
gracillima, 77.
longipalpis, 77.
longipes, 77.
longipetiolata, 77.
miocenica, 76.
nitens, 77.
Leng, Charles W., the species of *Brachyacantha* of North and South America, 279–333.
Ligyrus **compositus**, 59.

Lithocosmus coquilletti, 81.
Loncheres **carrikeri**, 251.
punctatus, 251, 252.
Lonchorina aurita, 267.
Lymexylon **lacustrinum**, 57.

MAGDALIS **striaticeps**, 66.
Magus ochreatus, 337.
Mammals, various species, their habits in relation to concealment, 166–170; size and coloration in relation to conspicuousness, 170–208.
Marmosa fuscata, 246.
mitis casta, 246.
Marphysa **fragilis**, 2–5.
Mazama rufa, 248.
Megacosmus **secundus**, 80.
Melanderella glossalis, 81.
Menidia audens, 276.
gracilis, 276.
Metachirus opossum fuscogriseus, 247.
opossum melanurus, 247.
opossum opossum, 246, 247.
opossum pallidus, 247.
Micronycteris megalotis, 266.
Mimon bennettii, 267.
Miodytiscus hirtipes, 54.
Molossus obscurus, 271.
Monomorium carbonarium ebeninum, 22.
destructor, 22.
floricola, 22.
Moxostoma **alleghaniensis**, 275.
Mus **andrewsi**, 336.
buruensis, 336.
luzonensis, 336.
mindorensis, 336.
musschenbroekii, 337.
neglectus, 336.
rajah, 336.
Myctophum affine, 14.
antarcticum, 13.
colletti, 13.
humboldti, 14.

NASALIS larvatus, 337.
Nasua phæocephala, 257.
Necropsylla **rigidula**, 75.
Neuroterus confusus, 363.
Nichols, John Treadwell, notes on Teleostean fishes from the eastern United States, 275–278.
Nicidion kinbergii, 7.
Nycticebus, 341.

ODONTOMACHUS hæmatodes, 22.
hæmatodes var. hirsutiusculus, 22.
Oligocene and Post-Oligocene erosion, 86–88.
Orzyomys delicatus, 253.
meridensis, 252, 253.
modestus, 253.
navus messorius, 254.
(Melanomys) venezuelensis, 254.
(Oligoryzomys) messorius, 254.
(Oligoryzomys) tenuipes, 253.
Ostrich, habits of, and its conspicuousness in the African landscape, 143.
Otiorhynchites **florissantensis**, 64.

PACHYCONDYLA harpax, 21.
Palæovespa scudderi, 72, 73.
Paussopsis **nearctica**, 71.
Papio, 341.
Peropteryx canina, 261.
kappleri, 260.
Phalanger ursinus, 335.
Pheidole biconstricta, 26.
carribbæa, 23.
fallax, 23.
flavens var. near thomensis, 26.
megacephala, 23.
punctatissima jamaicensis, 26.
radoszkowskii var. opacissima, 23.
subarmata, 23, 26.
(Ceratopheidole) **hecate**, 26.
(Ceratopheidole) hecate **malevola**, 27.
Philander, 246.
regina, 246.
Phocœna, 32.
dalli, 31, 34, 35, 36, 41.
phocœna, 31.
spinipinnis, 31.
Phocœnoides, 31.
truei, 32–50.
Phodotes tumidirostris continentis, 270.
Phyllostomus hastatus, 267.

Pithecus, 341.
mandibularis, 338.
philippinensis, 338.
Platythyrea punctata, 21.
Plecia heteroptera, 78.
melanderi, 77.
Ponera fœda, 22.
opaciceps, 22.
Prenolepsis (Nylanderia) fulva, 29.
(Nylanderia) longicornis, 29.
Pronghorn antelope, its advertising coloration and habits, 175.
Proechimys cherriei, 251.
guiræ, 251.
Promops barbatus, 271.
milleri, 271.
Proneoglaphyroptera, 77.
Pseudomyrma delicatula, 22.
elongata, 22.
gracilis, 22.
Pterontus davyi, 265, 222.
davyi fulvus, 265.
suapurensis, 265.
Pteronura brasiliensis, 256.
Pteropus alecto, 337.
Putorius affinis, 256.

Rhinoscopelus coccoi, 16, 17.
tenuiculus, 15.
Rhipidomys nitela, 254.
Rhopalothrix simoni var. wighti, 28.
Rhynchiscus naso, 260.
Roosevelt, Theodore, revealing and concealing coloration in birds and mammals, 119–131; list of big game studied in North America and Africa, 198; reply to Abbott H. Thayer's criticisms of 'American Game Trails', 221–231.

Saccopteryx bilineata, 260.
leptura, 260.
Sciurus **beebei**, 338.
flammifer, 254.
griseogena, 255.
quinquestriatus, 338.
rufoniger pluto, 337.
(Guerlinguetus) æstuans gilvigularis, 255.
Scopelus colletti, 13.
Scyphophorus **tertiarius**, 68, 69.
Simia ceylonica, 341.
cynocephala, 341.
cynocephala ceylonica, 341.
faunus, 341.
midas, 341, 342.
nictitans, 342.
sylvestris, 341.
Sinclair, W. J., and Walter Granger, Eocene and Oligocene of the Wind River and Big Horn Basins, 83–117.
Skunks the most conspicuous objects in nature, 204.
Solenopsis azteca, 23.
azteca var. pallida, 23.
geminata, 23.
hammari, 23.
Spathogaster quercus laurifoliæ, 363.
Stathmonotus tekla, 278.
Streblosoma **verrilli**, 11, 12.
Strumigenys alberti var. **nigrescens**, 28.
Sturnira lilium, 269.
Sus celebensis, 335.
Sylvilagus cumanicus, 249.
Symphoromyia fera, 78.
flavipalpis, 78.
pachyceras, 78.
pullata, 78.
subtrita, 78.
Synchroa **quiescens**, 62, 63.
Synodus fœtens, 278.

Tachinus sommatus, 56.
Tamandua longicaudata, 248.
Tamiops leucotis, 339.
mcclellandii formosanus, 339.
mcclellandii hainanus, 339.
sauteri, 339.
Tapinoma melanocephalum, 29.
Taracticus **renovatus**, 80.
Tayassu torvum, 248.
Tayra barbara barbara, 256.
Tetramorium guineense, 28.
(Tetrogmus) simillmum, 28.
Thayer, G. H. and Abbott H., critical review of their 'Concealing Coloration in the Animal Kingdom,' 119–221.

Toxorhynchus **grandis**, 63.
Trachops cirrhosus, 267.
Tragulus borneanus, 335.
Treadwell, Aaron L., polychætous annelids from the Dry Tortugas, Florida, 1–12.
Tursiops gillii, 233, 234, 235, 236, 237.
nuuanu, **233**, 234, 235, 236, 237.
truncatus, 234, 235,
tursio, 235, 236.

Urocyon aquilus, 258, 259.
cinereoargentea guatemalæ, 259.
cinereoargentea **venezuelæ**, 259.
Uroderma bilobatum, 269.

Wapiti, its coloration and habits, 177, 180.
Wasmannia auropunctata, 28.
Wheeler, William Morton, additions to the ant-fauna of Jamaica, 21–29.
Wickham, H. F., fossil Coleoptera from Florissant, with descriptions of several new species, 53–69.
Wind River and Big Horn Basins, diastrophic movement involving the Eocene in, 111.
Wind River and Big Horn Basins, life conditions during the Eocene and Oligocene, 112–117.
Wind River, the lost cabin section of, 103–105.

Zebra, its coloration not concealing, 192.

(*Continued from 4th page of cover.*)

PART II.— Cairns of British Columbia and Washington. By Harlan I. Smith and Gerard Fowke. Pp. 55–75, pll. i–v. January, 1901. Price, $1.00.

PART III.— Traditions of the Quinault Indians. By Livingston Farrand, assisted by W. S. Kahnweiler. Pp. 77–132. January, 1902. Price, $1.00.

PART IV.— Shell-Heaps of the Lower Fraser River. By Harlan I. Smith. Pp. 133–192, pll. vi–vii, and 60 text figures. March, 1903. Price, $1.00.

*PART V.— The Lillooet Indians. By James Teit. Pp. 193–300, pll. viii and ix, 40 text figures. 1906. Price, $1.80.

*PART VI.— Archæology of the Gulf of Georgia and Puget Sound. By Harlan I. Smith. Pp. 301–442, pll. x–xii, and 98 text figures. 1907. Price, $3.00.

*PART VII.— The Shuswap. By James Teit. Pp. 443–789, pll. xiii–xiv, and 82 text figures. 1909. Price, $6.00.

Vol. V. Anthropology.

Jesup North Pacific Expedition, Vol. III.

PART I.— Kwakiutl Texts. By Franz Boas and George Hunt. Pp. 1–270. January, 1902. Price, $3.00.

PART II.— Kwakiutl Texts. By Franz Boas and George Hunt. Pp. 271–402. December, 1902. Price, $1.50.

*PART III.— Kwakiutl Texts. By Franz Boas and George Hunt. Pp. 403–532. 1905. Price, $1.40.

Vol. VI. Anthropology.

Hyde Expedition.

The Night Chant, a Navaho Ceremony. By Washington Matthews. Pp. i–xvi, 1–332, pll. i–viii (5 colored), and 19 text figures. May, 1902. Price, $5.00.

Vol. VII. Anthropology (not yet completed).

Jesup North Pacific Expedition, Vol. IV.

PART I.— The Decorative Art of the Amur Tribes. By Berthold Laufer. Pp. 1–79, pll. i–xxxiii, and 24 text figures. December, 1901. Price, $3.00.

Vol. VIII. Anthropology.

**Jesup North Pacific Expedition, Vol. V.*

PART I.— The Haida of Queen Charlotte Islands. By John R. Swanton. Pp. 1–300, pll. i–xxvi, 4 maps, and 31 text figures. Price, $8.00.

PART II.— The Kwakiutl of Vancouver Island. By Franz Boas. Pp. 301–522, pll. xxvii–lii, and 142 text figures. 1909. Price, $10.00.

Vol. IX. Zoölogy and Palæontology.

PART I.— The Osteology of *Camposaurus* Cope. By Barnum Brown. Pp. 1–26, pll. i–v. December, 1905. Price, $2.00.

PART II.— The Phytosauria, with Especial Reference to *Mystriosuchus* and *Rhytiodon*. By J. H. McGregor. Pp. 27–101, pll. vi–xi, and 26 text figures. February, 1906. Price, $2.00.

PART III.— Studies on the Arthrodira. By Louis Hussakof. May, 1906. Pp. 103–154, pll. xii and xiii, and 25 text cuts. Price, $3.00.

PART IV.— The Conard Fissure, A Pleistocene Bone Deposit in Northern Arkansas, with Descriptions of two New Genera and twenty New Species of Mammals. By Barnum Brown. Pp. 155–208, pll. xiv–xxv, and 3 text-figures. 1907. Price, $2.50.

PART V.— Studies on Fossil Fishes (Sharks, Chimæroids, and Arthrodires). By Bashford Dean. Pp. 209–287, pll. xxvi–xli, and 65 text figures. February, 1909. Price, $3.50.

PART VI.— The Carnivora and Insectivora of the Bridger Basin, Middle Eocene. By W. D. Matthew. Pp. 289–567, pll. xlii–lii, and 118 text figures. August, 1909. Price, $5.00.

Vol. X. Anthropology.

**Jesup North Pacific Expedition, Vol. VI.*

PART I.— Religion and Myths of the Koryak. By W. Jochelson. Pp. 1–382, pll. i–xiii, 1 map, and 58 text figures. 1905. Price, $10.00.

PART II.— Material Culture and Social Organization of the Koryak. By W. Jochelson. Pp. 383–811, pll. xiv–xl, and 194 text figures. 1908. Price, $12.00.

Vol. XI. Anthropology.

**Jesup North Pacific Expedition, Vol. VII.*

PART I.— The Chuckchee: Material Culture. By W. Bogoras. Pp. 1–276, pll. i–xxxi, 1 map, and 199 text figures. 1904. Price, $8.00.

(*Continued on 2d page of cover.*)

PUBLICATIONS

OF THE

American Museum of Natural History.

The publications of the American Museum of Natural History consist of the 'Bulletin,' in octavo, of which one volume, consisting of 400 to 800 pages and 25 to 60 plates, with numerous text figures, is published annually; the 'Memoirs,' in quarto, published in parts at irregular intervals; and 'Anthropological Papers,' uniform in size and style with the 'Bulletin.' Also an 'Ethnographical Album,' and the 'American Museum Journal.

MEMOIRS.

Each Part of the 'Memoirs' forms a separate and complete monograph, usually with numerous plates.

Vol. I. Zoölogy and Palæontology.

PART I.— Republication of Descriptions of Lower Carboniferous Crinoidea from the Hall Collection now in the American Museum of Natural History, with Illustrations of the Original Type Specimens not heretofore Figured. By R. Z. Whitfield. Pp. 1–37, pll. i–iii, and 14 text figures. September 15, 1893. Price, $2.00.

PART II.— Republication of Descriptions of Fossils from the Hall Collection in the American Museum of Natural History, from the report of Progress for 1861 of the Geological Survey of Wisconsin, by James Hall, with Illustrations from the Original Type Specimens not heretofore Figured. By R. P. Whitfield. Pp. 39–74, pll. iv–xii. August 10, 1895. Price, $2.00.

PART III.— The Extinct Rhinoceroses. By Henry Fairfield Osborn. Part I. Pp. 75–164, pll. xiia–xx, and 49 text figures. April 22, 1898. Price, $4.20.

PART IV.— A Complete Mosasaur Skeleton. By Henry Fairfield Osborn. Pp. 165–188, pll. xxi–xxiii, and 15 text figures. October 25, 1899.

PART V.— A Skeleton of Diplodocus. By Henry Fairfield Osborn. Pp. 189–214, pll. xxiv–xxviii, and 15 text figures. October 25, 1899. Price of Parts IV and V, issued under one cover, $2.00.

PART VI.— Monograph of the Sesiidæ of America. North of Mexico. By William Beutenmüller. Pp. 215–352, pll. xxix–xxxvi, and 24 text figures. March, 1901. Price, $5.00.

PART VII.— Fossil Mammals of the Tertiary of Northeastern Colorado. By W. D. Matthew. Pp. 353–448, pll. xxxvii–xxxix, and 34 text figures. Price, $2.00.

PART VIII.— The Reptilian Subclasses Diapsida and Synapsida and the Early History of the Diaptosauria. By Henry Fairfield Osborn. Pp. 449–507, pl. xl, and 28 text figures. November, 1903. Price, $2.00.

Vol. II. Anthropology.

Jesup North Pacific Expedition, Vol. I.

PART I.— Facial Paintings of the Indians of Northern British Columbia. By Franz Boas. Pp. 1–24, pll. i–iv. June 16, 1898. Price, $2.00.

PART II.— The Mythology of the Bella Coola Indians. By Franz Boas. Pp. 25–127, pll. vii–xii. November, 1898. Price, $2.00.

PART III.— The Archæology of Lytton, British Columbia. By Harlan I. Smith. Pp. 129–161, pl. xiii, and 117 text figures. May, 1899. Price, $2.00.

PART IV.— The Thompson Indians of British Columbia. By James Teit. Edited by Franz Boas. Pp. 163–392, pll. xiv–xx, and 198 text figures. April, 1900. Price, $5.00.

PART V.— Basketry Designs of the Salish Indians. By Livingston Farrand. Pp. 393–399, pll. xxi–xxiii, and 15 text figures. April, 1900. Price, 75 cts.

PART VI.— Archæology of the Thompson River Region. By Harlan I. Smith. Pp. 401–442, pll. xxiv–xxvi, and 51 text figures. June, 1900. Price, $2.00.

Vol. III. Anthropology.

PART I.— Symbolism of the Huichol Indians. By Carl Lumholtz. Pp. 1–228, pll. i–iv, and 291 text figures. May, 1900. Price, $5.00.

PART II.— The Basketry of the Tlingit. By George T. Emmons. Pp. 229–277, pll. v–xviii, and 73 text figures. July, 1903. Price, $2.00. (Out of print.)

PART III.— Decorative Art of the Huichol Indians. By Carl Lumholtz. Pp. 279–327, pll. xix–xxiii, and 171 text figures. November, 1904. Price, $1.50.

PART IV.— The Chilkat Blanket. By George T. Emmons. With Notes on the Blanket Designs, by Franz Boas. November, 1907. Price, $2.00.

Vol. IV. Anthropology.

Jesup North Pacific Expedition, Vol. II.

PART I.— Traditions of the Chilcotin Indians. By Livingston Farrand. Pp. 1–54, June, 1900. Price, $1.50.

(*Continued on 3rd page of cover.*)

THE LIBRARY SMITHSONIAN INSTITUTION

THE LIBRARY SMITHSONIAN INSTITUTION
FOR THE INCREASE AND DIFFUSION OF KNOWLEDGE AMONG MEN
SMITHSONIAN INSTITUTION WASHINGTON 1846
Heckman Bindery
N. MANCHESTER

SMITHSONIAN INSTITUTION LIBRARIES
3 9088 01262 7436